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1936 • 1937

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Empire Building, Pittsburgh, Pa.

IRON AND STEEL ENGINEER

VOL. XIII AUGUST • 1936 NO. VIII

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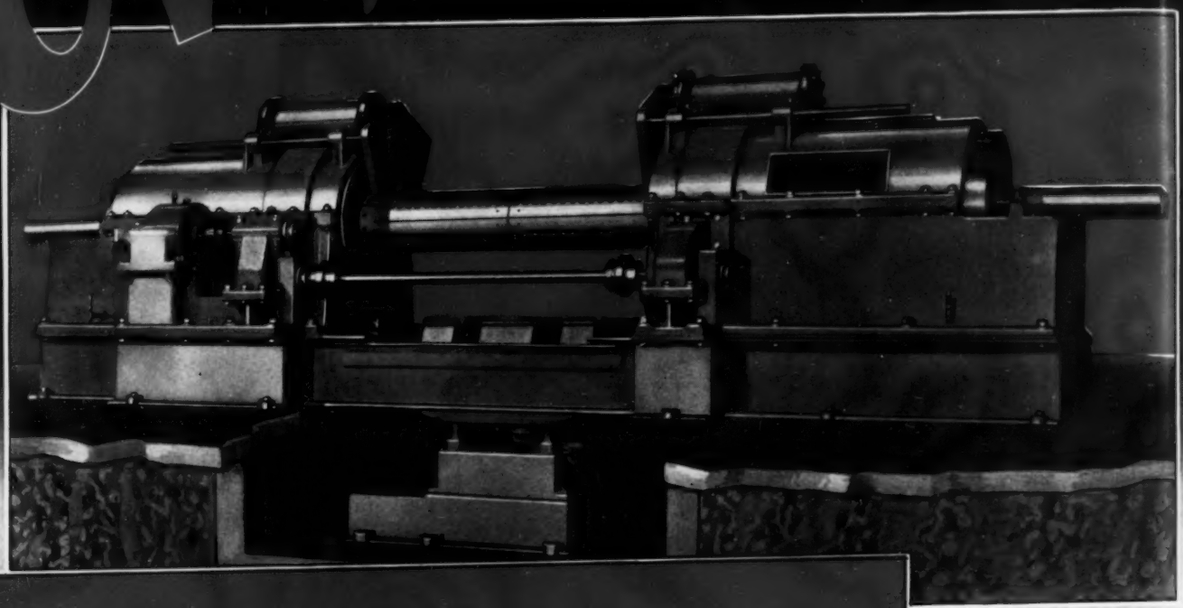
New! WIDE STRIP REELS



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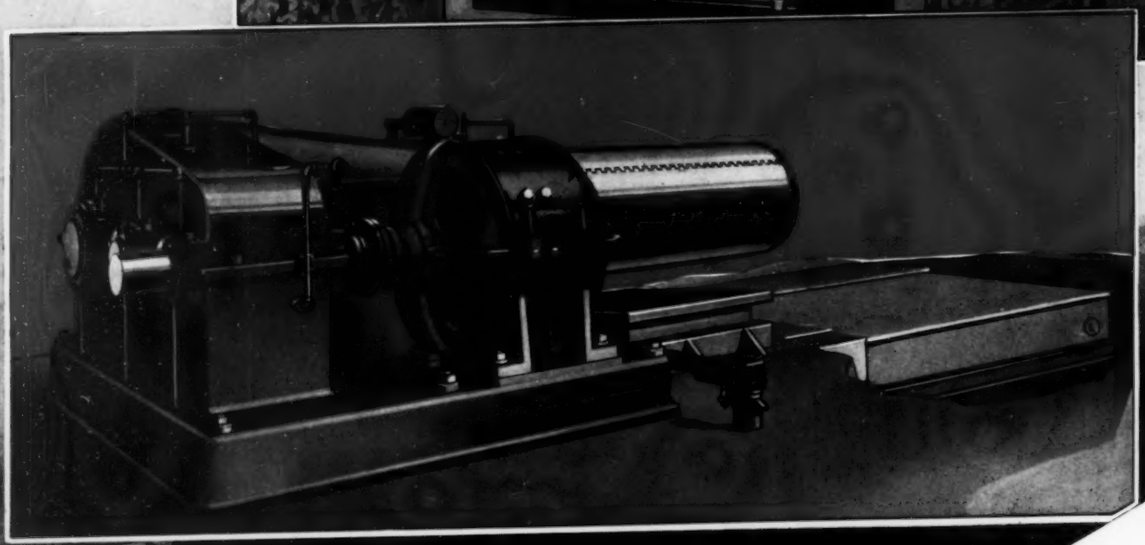

OVER HUNG TYPE

THE WEAN ENGINEERING CO., INC.
WARREN, OHIO

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THE Annual Convention and Exposition to be held in Detroit, Michigan, September 22 to 25, promises to be the largest, most interesting and instructive event the Association has ever held.

During the past several years the attendance of representatives of the steel companies has been of an unusual high standard. In view of the continued fine work by the Association, we are assured of having the most representative group of steel officials that ever attended our Annual Meeting. Locally a great deal of of interest in our program is also being shown by the automotive executives thus insuring a complete attendance at the meetings and Iron and Steel Exposition, details of which are outlined in this issue of the Iron and Steel Engineer.

It is requested that each member register promptly on their arrival at the hotel and secure full information in regard to such items as time and place of the meetings and the exposition so they will be able to plan a program to their advantage and satisfaction.

The President's Message

By H. G. R. BENNETT
New President of A. I. & S. E.

IT is with some feeling of trepidation that I assume the honor and office of President of our Association succeeding G. R. Carroll who has so ably directed the activities of the organization throughout the past year. So much of importance has happened during this period—namely, the change of name of the Association has been consumated after a long period of consideration—plans have been completed for the largest convention and the most extensive and interesting exhibit ever arranged by the Association and a most notable improvement in the editorial and general make up of the official publication, the Iron and Steel Engineer has been made.

To keep the proper momentum in our program of activities which such progress merits means a broad responsibility which I gladly accept feeling assured of the full cooperation and assistance of our Board of Directors and Managing staff.

We enter the year 1936-1937 with an impressive record of past accomplishments in the Iron and Steel Industry, and with many auguries for a still brighter future. Let us review some of the facts and figures illustrative of the great growth of the Iron and Steel business since its early days, and some of the improvements to which the engineer has contributed in making progress possible.

It was 80 years ago that Sir Henry Bessemer began his investigation into the possibility of producing an improved quality of iron, and during that same period the first 30 foot rails rolled in this country are said to have been produced. Sixty years ago, the first 60-foot rails rolled in the United States were manufactured, and this same period also saw the first steel wire nails.

Forty years ago, George B. Selden secured a United States Patent covering the idea of "Applying an Internal Combustion Engine to the Propulsion of a Vehicle." The original patent application had been made 23 years earlier. Selden's idea, and his broad basic patent, marked the beginning of the automobile industry.

Twenty years ago, the iron and steel business reached the most prosperous period of its history, but the sudden demand for increased output of iron and steel products was so great that a large portion of the activities of plant personnel was directed to increasing output, rather than toward important technical advances.

In 1935, a total of 21,100,000 tons of pig iron were produced in the United States, in comparison with 165,000 tons 100 years ago.

There is perhaps, no field in the steel industry in which more progress has been made than that of fuel conservation. Twenty years ago, the coke used to produce a ton of pig iron in a well-operated plant was in the neighborhood of 2200 pounds, while today it is about 1900 pounds. A similar improvement has been made in the percentage of the blast furnace gas used in stoves. This, due to improvement in stoves and burners, has dropped from more than 30 percent to 20% or less.

The surplus gas 20 years ago was either burned under boilers at 50 to 60 percent efficiency, or wasted to the atmosphere. Today, in a well-ordered plant, it is burned under boilers with an efficiency of 80 percent, or mixed with gasses of higher calorific value and used for metallurgical purposes.

The experience with open hearth practice has been similar. Where 20 years ago the plant which was producing steel on 550 pounds of coal, or 7,500,000 B.T.U. was not considered to be doing a bad job—today a good plant will do it on 280 pounds, or slightly less than 4,000,000 B.T.U.

The advancements in steel making practices which I have enumerated are only a few of the many which have been made in the industry. The engineer has contributed much in bringing about these improvements. Likewise, the vision shown by the Association in anticipating such problems and needs of the industry, as come within its scope, will be manifested in an even closer spirit of cooperation among its members.

The future is brightened by generally improved business conditions and the most favorable increase has

Herbert G. R. Bennett began work in the steel industry in 1901 as secretary to the chief engineer, American Steel Hoop Company. He went with Carnegie Steel Company, Youngstown, in 1907, as special engineer, later holding the positions of master mechanic, assistant superintendent of bar mills, and in 1933 he was advanced to his present position with the company.

H. G. R. BENNETT
Assistant General Superintendent
CARNEGIE-ILLINOIS STEEL CORPORATION
DUQUESNE, PA.

been enjoyed by the automotive industry. It used fully 25 percent of the rolled steel products produced last year, an enormous tonnage and more than was used by any other two consuming groups, and this year has witnessed an additional material improvement.

One of the broadest phases of the Association's purposes is the improvement in the relations between those of the iron and steel industry and others who have mutual interests. The selection of Detroit for our next Convention embodies this idea as it presents a splendid opportunity for the automotive trade and the steel manufacturers to discuss mutual problems.

I wish to take this opportunity to extend a cordial invitation to members and friends of the Association to participate in this program for their own benefit as well as that of the Association.

NEWLY ELECTED OFFICERS

of the

ASSOCIATION OF IRON AND STEEL ENGINEERS

Julius A. Clauss started his steel mill career with the Lackawanna Steel Company, which company he was with for seven years. He then went with Corrigan-McKinney Steel Company for two and one-half years as chief designer and checker. Following this he was the chief draftsman for the William Todd Company at Youngstown. Leaving this company he went with the Republic Iron and Steel Company as assistant chief draftsman for twelve years. The next three and one-half years he served as chief engineer for the Trumbull Steel Company and from March 1929 has been the chief engineer of the Great Lakes Steel Corp.

Louis F. Coffin began work with the Bethlehem Company as mechanical engineer in 1916. In 1920 he was made general master mechanic, and in 1932 he was advanced to his present position as superintendent of the mechanical department with the Bethlehem Company, Sparrows Point, Md. Mr. Coffin was graduated from Swarthmore College in 1909 with a degree of Bachelor of Science in mechanical engineering.

J. Ledlie Miller has been assistant chief engineer, Youngstown Works, Carnegie-Illinois Steel Corporation since February, 1928. He has been connected with the steel industry since 1909, allowing for two years World War service. Mr. Miller was awarded his B.S. degree in mechanical engineering by Carnegie Institute of Technology, 1920.

Clinton Curler Pecu, has been with the Bethlehem Steel Company 34 years and has held his present position as lubrication engineer for 27 years. Prior to his connection with this company, he was 14 years foreman of the spring department, Haviland Shade Roller Company, Vergennes, Vermont.

C. Clarke Wales, after being graduated from the University of Toronto with degree of B.A., S.C. in Mechanical Engineering, entered the employ of the Westinghouse Electric & Manufacturing Company at East Pittsburgh. In 1925 he joined the Otis Steel Company later becoming assistant metallurgist and then superintendent of the open hearth, 40″ blooming mill and bar mills. For the past seven years serving as chief engineer of this company during which period he directed and planned the construction of the 72″ hot and cold strip mills.

Guy N. Hughes has been with the Gulf States Steel Company since 1930, as the electrical superintendent coming here from the Westinghouse Electric & Manufacturing Company, Atlanta, where he was service engineer for five years. Prior to his service with the Westinghouse Company, he was eight years construction foreman and assistant electrical superintendent, Aluminum Company of America, at Alcoa, Tennessee. Mr. Hughes holds a Bachelor of Science degree from the University of Tennessee, Knoxville.

Left
JULIUS A. CLAUSS

Right
CLINTON CURLER PECU

Lower Left
LOUIS F. COFFIN

Lower Right
C. CLARKE WALES

J. LEDLIE MILLER

GUY N. HUGHES

RAYMOND G. ADAIR

JOHN W. BATES

WILLIAM A. PERRY

FRANK EDWARD FLYNN

Raymond G. Adair, assistant works manager, Butler, Pa., has been with the American Rolling Mill Company his entire steel mill career.

John W. Bates, was graduated from the Alabama Polytechnic Institute in 1924. He then entered an apprentice course with the American Telephone and Telegraph Co., in Atlanta. In the latter part of 1924 he entered the employ of the Duquesne Light Co. at Colfax Power Station serving as a member of the maintenance department, electrical station operator, and efficiency engineer. For the past nine years Mr. Bates has been electrical engineer for the Power Division of the American Sheet and Tin Plate Co., which organization was recently merged with the Carnegie-Illinois Steel Corporation.

William A. Perry started with the Inland Steel Company twenty six years ago and successively held the positions of mill motor foreman, assistant superintendent of power stations, and assistant electrical superintendent. He was advanced to his present position as superintendent electrical and power departments with the company in January 1931.

Frank Edward Flynn started in the steel business with the Superior Steel Company at Carnegie, progressing from the position of water boy to that of boss roller. In 1916 he started in charge of rolling at the Phillips Sheet and Tin Plate Company, which later became the Weirton Steel Company, and during his 11 years service there he became assistant manager and then manager. He came to The Trumbull Steel Company in 1928 as assistant vice president in charge of operations. This company later became a unit of Republic Steel Corporation, and he was made assistant district manager. When the general offices of Republic Steel Corporation were moved to Cleveland, he became general superintendent in charge of all operations at the Warren Division, which is composed of the Warren, Niles, Trumbull-Cliffs and Newton Falls Works.

Harry G. Hague, started with the Illinois Steel Company in 1909 as a special electrician, and in 1915 was transferred to the Gary Sheet Mill, American Sheet and Tin Plate Company, as chief electrician. He was appointed to his present position of superintendent of electrical maintenance in 1924. Mr. Hague is an alumnus of Loyola University, Chicago, class of 1903, and of Notre Dame University, class of 1908.

Charles L. McGranahan's first work in the steel industry was in 1916 with American Sheet & Tin Plate Company. He worked in various positions with the company at their different plants until 1931, allowing for one year World War service. In 1931 he joined Inland Steel Company as superintendent of the company's Indiana Harbor hot strip mill, resigning in February, this year, to take his present post as assistant general superintendent with the Jones & Laughlin Steel Corporation, Pittsburgh, Pa. Mr. McGranahan was graduated from Pennsylvania State College in 1916 with a B.S. degree in Civil Engineering.

Martin J. Conway was educated in mechanical and chemical engineering at Hanley and Oxford Universities, England. From 1920 to 1923 he was fuel engineer for Pittsburgh Crucible Steel Company, Midland, Penna., and held a similar position at the Steubenville plant of the Wheeling Steel Corp. from 1923 to 1926. For the past ten years he has been associated with the Lukens Steel Company as fuel engineer.

Frank E. Leahy has been fuel engineer for the Youngstown Sheet and Tube Company for the past nine years. Prior to joining his present company, Mr. Leahy was with Carnegie Steel Company as steam and fuel engineer; and steam engineer and superintendent of power with National Tube Company. Mr. Leahy received his degree in mechanical engineering from Stevens Institute of Technology.

HARRY G. HAGUE

CHARLES L. McGRANAHAN

MARTIN J. CONWAY

FRANK E. LEAHY

Tentative Program

32ND ANNUAL CONVENTION AND IRON AND STEEL EXPOSITION

DETROIT, MICHIGAN

SEPTEMBER 22, 23, 24, 25, 1936

Technical Sessions
Hotel Statler

Iron and Steel Exposition
Convention Hall, Cass Avenue

TUESDAY, SEPTEMBER 22, 1936

Ball Room Floor, Hotel Statler

9:00 A. M. Registration, Assembly Hall.

9:15 A. M. Annual Meeting and Business Session

Large Banquet Room

9:30 A.M.

"DEVELOPMENTS IN THE IRON AND STEEL INDUSTRY DURING 1935-1936" by W. H. Burr, Electrical and Mechanical Superintendent, Lukens Steel Company, Coatesville, Pa.

10:00 A.M.

"STEEL SHEETS FOR TODAY'S MOTOR CAR—MECHANICAL AND ELECTRICAL PROBLEMS OF FABRICATION" by Thomas P. Archer, Vice President in Charge of Operations, Fisher Body Company, Detroit, Michigan, and R. A. Geuder, Electrical Engineer, Reliance Electric and Engineering Company, Cleveland, Ohio.

10:45 A.M.

"DEVELOPMENTS IN THE FLAT ROLLED STEEL INDUSTRY DURING 1935-1936" by Stephen Badlam, Consulting Engineer, Pittsburgh, Penna.

2:00 P.M.

Ball Room

"MATERIAL HANDLING FACILITIES FOR HOT AND COLD STRIP MILLS" by F. M. Gillies, Assistant General Superintendent, Inland Steel Company, Indiana Harbor, Indiana.

2:45 P.M.

"ELECTRICAL APPLICATIONS IN CONTINUOUS HOT STRIP MILLS" by L. A. Umansky, Industrial Engineering Department, General Electric Company, Schenectady, N. Y.

3:00 P.M.

"RUNOUT TABLE MOTORS" by F. E. Harrell, Assistant Chief Engineer, Reliance Electric and Engineering Company, Cleveland, Ohio.

7:30 P.M.

VISIT TO IRON AND STEEL EXPOSITION, CONVENTION HALL, CASS AVENUE, by National Officers, National Engineering Committees, Members and Guests of the Association of Iron and Steel Engineers.

9:00 P.M.

EXHIBITOR'S INFORMAL DANCE, Ball Room, Hotel Statler, Detroit, Michigan.

WEDNESDAY, SEPTEMBER 23, 1936

Ball Room Floor, Hotel Statler

Large Banquet Room

9:15 A.M.

"BRIGHT ANNEALING AND NORMALIZING AUTO BODY STOCK STEEL IN ELECTRIC FURNACES" by F. T. Hague, Manager DC Engineering Department and P. H. Brace, Manager, Metallurgical Department, Research Division, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

10:00 A.M.

"SHEET AND STRIP STEEL FOR DEEP DRAWING PURPOSES" by Joseph Winlock, Chief Metallurgist, Edward G. Budd Manufacturing Company, Philadelphia, Pa.

11:00 A.M.

"HEAT TREATING ALLOY BAR STOCK IN ELECTRIC FURNACES" by Dr. Marcus A. Grossmann, Director of Research, Carnegie-Illinois Steel Corporation, Chicago, Ill.

11:45 A.M.

"The Development of the Great Lakes Steel Corporation" by George R. Fink, President, Great Lakes Steel Corporation, Ecorse, Michigan.

12:45 P.M.

Inspection Trip, Great Lakes Steel Corporation, Ecorse, Michigan. Special buses which the A. I. & S. E. will provide and the guests must use, will leave the Hotel Statler at 12:45 P.M. (E.S.T.). Price $2.00 per person.

THURSDAY, SEPTEMBER 24, 1936

Combustion Engineering Division

Large Banquet Hall, Ball Room Floor, Hotel Statler

9:30 A.M.

"Automatic Control in Open Hearth Furnaces" by A. F. Spitzglass, Vice President, Republic Flow Meters Company, Chicago, Ill.

10:15 A.M.

"The Trend in Refractories Application in the Steel Plant" by A. V. Leun, Refractory Engineer, Bethlehem Steel Company, Bethlehem, Pa.

11:00 A.M.

"Soaking Pits" by P. M. Offill, Vice President, Amsler Morton Company, Pittsburgh, Pa.

Lubrication Engineering Division

Small Banquet Hall, Ball Room Floor, Hotel Statler

9:30 A.M.

"Centralized Lubrication and Roll Cooling Systems" by T. J. Kauffeld, Special Representative, DeLaval Separator Company, Pittsburgh, Pa.

10:15 A.M.

"Lubrication of Steel Mill Equipment" by C. J. Klein, Chief Engineer, Weirton Steel Company, Weirton, West Va.

Large Banquet Hall

1:15 P.M.

"Recent Improvements in Rolling Mills at the Ford Motor Company" by M. Stone, Engineer, United Engineering and Foundry Company, Pittsburgh, Pa.

Large Banquet Hall
Combustion Engineering Division

2:15 P.M.

"Gas Distribution at the Ford Motor Company" by F. J. Harlow, Manager, Industrial Division, Philgas Department, Phillips Petroleum Company, Detroit, Michigan.

3:00 P.M.

"Study of Blast Furnace Charging" by Gordon Fox, Vice President, Freyn Engineering Company, Chicago, Ill.

4:00 P.M.

"Recuperators for Continuous Slab Heating Furnaces" by W. H. Fitch, Manager, Recuperator Department, Carborundum Company, Perth Amboy, N. J.

Ball Room Floor, Hotel Statler

Welding Engineering Division

2:00 P.M.

"Developments in Welding During 1935-1936" by Grover A. Hughes, Electrical Engineer, Truscon Steel Company, Youngstown, Ohio.

2:30 P.M.

"Resistance Welding in Steel Plants" by Walter Anderson, President and Malcomb Clark, General Manager, Taylor Winfield Corporation, Warren, Ohio.

3:00 P.M.

"How Arc Welding Aids in the Use of Standard Steel Mill Products in the Electrical Industry" by O. A. Tilton, Industrial Engineering Department, General Electric Company, Schenectady, N. Y.

3:30 P.M.

"Applications of Flash Welding" by Representative from Federal Machine & Welder Company, Warren, Ohio.

10:00 P.M.

Formal Reception, Ball Room, Hotel Statler, Detroit, Michigan

FRIDAY, SEPTEMBER 25, 1936

9:45 A.M.

Inspection Trip, Steel Plant, Rolling Mills and Assembly Line, Ford Motor Company, Detroit, Michigan. Special buses which the guests must use, will leave the Hotel Statler at 9:45 A.M. (E.S.T.). Price $2.00 per person.

EXPOSITION HOURS

Tuesday—September 22—1:00 P.M. to 10:00 P.M.
Wednesday—September 23—10:00 A.M. to 10:00 P.M.
Thursday—September 24—10:00 A.M. to 10:00 P.M.
Friday—September 25—10:00 A.M. to 10:00 P.M.

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STEEL MILL LIGHTING

RECENT DEVELOPMENTS AND IMPROVEMENTS

By WALTER STURROCK, Consulting Engineer
General Electric Company
Nela Park Engineering Department
CLEVELAND, OHIO

Paper presented before Philadelphia District Section A. I. & S. E. E., March 7, 1936

▲ THE RESEARCH laboratories in the lighting industry have, during the past few years, developed a new science of seeing which has established a fundamental basis for prescribing the amount of light necessary to carry on work. The researches in seeing which Dr. Luckiesh and Mr. Moss have conducted have established beyond reasonable doubt that human beings see most quickly and easily and with a minimum of wasted energy when their work is illuminated to levels of the order of those commonly found out-of-doors. Because of economic and engineering considerations, however, footcandle recommendations have always been a compromise between ideal and inadequate levels, and in practice have been much nearer the inadequate than the ideal. There has in the past been no rational method which the illuminating engineer might employ to enable him to prescribe lighting levels for various visual tasks. Except where specific tasks have been evaluated in the laboratory, it has been well-nigh impossible to determine with any fair degree of accuracy the relative severity of seeing tasks. How much harder is the seeing task in one case than in another? The answer has been in the past based on guesswork and so, perforce, has been the lighting recommendation.

For this reason the development recently of a technique and an instrument which make it possible to prescribe footcandles on a rational basis is considered a definite and important forward step in the progress of the lighting art. The visability meter, an instrument developed by Luckiesh and Moss, bids fair to revolutionize the present practice of lighting specification. As shown in illustration Fig. 1, the instrument resembles in a general way a large pair of goggles except that the apertures through which the observer looks are relatively small. The visibility meter consist essentially of two colorless filters with precise gradients of transmission-factor which may be rotated simultaneously before the eyes while looking at an object or while performing a visual task. The observer holds the instrument in approximately the same position in which eyeglasses are worn, and with a finger of the right hand slowly turns a disk which rotates the gradients until the visual threshold or the borderline of performance of the visual task is reached. These measurements of visibility may be made in a few seconds even by an untrained observer.

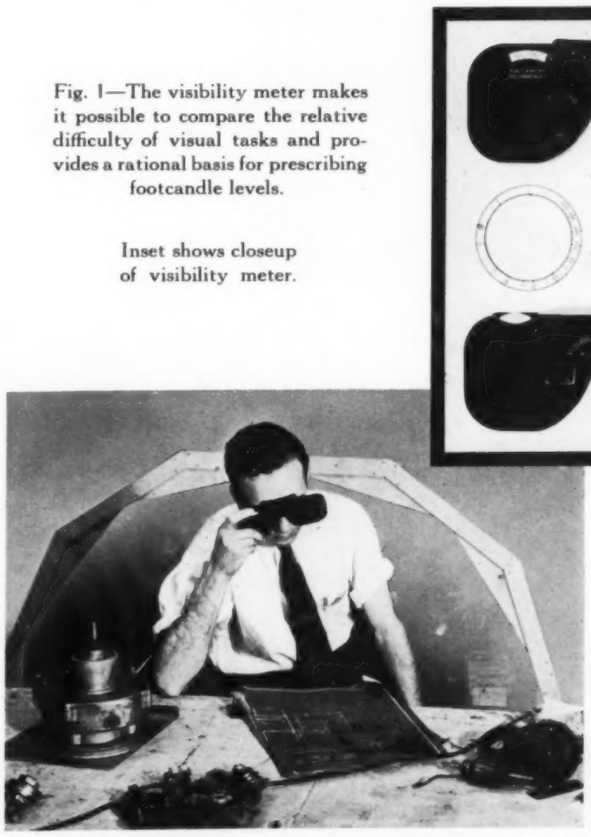

Fig. 1—The visibility meter makes it possible to compare the relative difficulty of visual tasks and provides a rational basis for prescribing footcandle levels.

Inset shows closeup of visibility meter.

The visibility of objects or visual tasks varies enormously and obviously is the fundamental factor in seeing. Upon visibility the efficiency and welfare of human beings largely depends. In seeing, the human seeing-machine is interested in (1) the visual task, (2) the visual sense, and (3) light and lighting. Visi-

bility involves these three realms and also certain *human* factors which can be taken care of by factors of safety determined by measurements of threshold visibility. Obviously little is known about anything until proper measurements are made. The visibility meter is a portable device developed to fill such a need in seeing.

The instrument has two *rational* scales which are based upon many years of research. These are:

Relative visibility—scale range, 1 to 20.

Footcandles recommended—scale range, 1 to 1000.

The visibility scale has an absolute rational basis founded upon the maximum ability of persons with average normal vision to recognize the details of a simple describable object of definite size and contrast. In an absolute sense a setting of unity on the visibility scale represents the limit of average normal vision under favorable conditions for seeing. The scale value "2" indicates that the object or task is *twice* as visible as the smallest object which can be recognized by persons with average normal vision. It is the scale of relative visibility that is used to determine the relative difficulty of two or more visual tasks.

(8-point Bodoni Book Monotype printed with black ink on white paper and illuminated to 10 foot).

If all visual tasks are studied with the visibility meter at the standard level of 10 footcandles, the scale reads directly the recommended footcandles whose actual values are an arbitrary compromise between ideals and practical engineering and economic factors. In using the meter where the actual footcandles (A) on the task differ from 10 footcandles, the scale reading of recommended footcandles should be multiplied by the ratio A/10. The instrument is intended to be used with a footcandle meter, such as illustrated in Fig. 2, so that the actual illumination on any task can readily be found.

Visual tasks in steel mills are of many different kinds, some of which are simple and easy while others are complex and difficult. In storage areas, passageways, and the like, the seeing task is easy and the illumination must only be sufficient to permit workmen to move about safely. On the other hand, in blooming mills, slabbing mills, sheet bar and skelp mills, and others where *semi-finished* work is done, there is a certain

Fig. 2—Small and compact, the light meter is indispensable to the lighting engineer and factory manager for checking illumination levels in the plant. Inset shows closeup of a light meter.

The scale values of recommended footcandles have *no obvious relation* to the scale values of relative visibility. They represent an arbitrary compromise between the footcandles necessary for barely seeing and the enormously higher footcandle-levels for easiest seeing as indicated by researches in seeing. That the scale of recommended footcandles is conservative is attested to by the fact that it is based upon the visibility of reading matter printed with 8-point (Bodoni) type and black ink on excellent white paper and illuminated to an intensity of 10 footcandles. This task corresponds to the scale value "10". A scale value of "20" for another task under the same intensity of illumination as the former basic task indicates that it should have 20 footcandles in order to be as visible or as easily performed as the foregoing standard task

amount of seeing light required in addition to that necessary for safety purposes. Moreover, in these mills, the safety requirements are greater than those for storage areas because rapidly-moving parts on machines and conveyors are hazards which do not exist in confined storage areas. A study of visual requirements in other departments of the steel mill indicates that minimum levels of the order of 10 footcandles should be used for processes such as found in wire mills, tube and pipe mills, rod mills, strip mills, and others where *finished* products are made. The proper *inspection* of these finished materials require still higher levels of illumination, depending upon the fineness in detail of the inspection. Practical and conservativ levels of general illumination for all these areas, as well as for other areas found in steel mills, are listed in Table I.

TABLE I

RECOMMENDED FOOTCANDLES OF ILLUMINATION FOR STEEL MILL AREAS

	Footcandles
Blacksmith Shop	10
Billet Mills	5
Blooming Mills	5
Boiler Room and Power House	5
Carpenter Shop	20
*Cold Strip Mills	10
Drafting Rooms	30
Foundries	5
Furnace Rooms	
Blast, Converter, Crucible, Electric, Open Hearth and Puddling	5
Hot Sheet Mills	10
Hot Strip Mills	10
Inspection	
Black Plate	30–50**
Bloom and Billet Chipping	30–50**
Tinplate and other Bright Surfaces	50–100**
Laboratories	
Chemical and Physical	15
Lockers and Washrooms	5
Machine Shops and Maintenance Dept. —Repair Shops	
Rough Bench and Machine Work	10
Medium Bench and Machine Work	20
Fine Work—Buffing, Polishing, etc.	50–100**
Extra Fine Work	100–or more**
*Merchant Mills	15
Offices	
Conference Rooms	10
General Purpose	20
Pattern Shop	20
*Pipe Mills	10
Power House and Boiler Room	5
*Rail Mills	10
Repair Shop (See Machine Shop and Carpenter Shop)	
*Rod Mills	10
*Sheared Plate Mills	15
Sheet Bar Mills	5
Skelp Mills	5
Slabbing Mills	5
Storage	
Interior	2
Exterior	1
Tinplate Mills	
Hot Strip Rolling	10
Cold Strip Rolling	15
Tinning Machine Department	10
Black Plate	30–50**
Tinplate	50–100**
*Tube Mills	10
*Universal Plate Mills	10
Washrooms and Lockers	5
*Wire Drawing	10
Yards—Outdoor Storage	1
Protective Lighting	0.2

*In these areas, many of the machines require one or more supplementary lighting units, mounted on them, in order to effectively direct light toward the working points.

**Illumination of this order may in some instances be provided from general lighting system. In other cases, it will be found more economical to provide a combination of general lighting plus supplementary. Direction of light, diffusion, eye protection, study of direct and reflected glare, as well as elimination of objectional shadows are all vitally important and must be considered.

These footcandles levels are truly conservative when we compare them with outdoor lighting. It wasn't very long ago that civilization brought mankind indoors. This change from an outdoor existence to a life lived predominantly indoors is perhaps the most outstanding transition which the human race has undergone within our knowledge. From a lighting standpoint, the change has been from hundreds or even thousands of footcandles of daylight to 1, 2, or perhaps 5 footcandles indoors. The human eye, which for ages developed for distant vision under the quantity and quality of natural daylight, has been called upon in a relatively few years to adapt itself to the enormously more severe demands of our present life. Due to the lack of adequate lighting, impairment of vision has resulted and will continue unless the fundamentals of good illumination are observed.

In the past many steel mill executives have considered good artificial lighting to be unnecessary for those sections of their plant operated only "during daylight". This line of reasoning is unsound because a large portion of the time natural daylight is insufficient to provide adequate illumination inside, even though large windows are provided. For instance, in Cleveland, Ohio, which is a fairly typical city, a summary of the weather bureau records for the past 29 years shows that the average 24-hour day consists of six hours of sunshine, six hours of cloudiness, and twelve hours of darkness. This, of course, varies with the season of the year; namely, for July there is approximately nine hours of sunshine, six hours of cloudiness, and nine hours of darkness, while for December there is only two hours of sunshine, seven hours of cloudiness, and fifteen hours of darkness.

Steel mills of the monitor or saw-tooth construction and with large side wall windows afford a maximum utilization of natural light. Such buildings may have adequate daylight for certain hours on bright days but they are nevertheless subject to continual variations in the amount of light because of clouds and the sun's position. It is, therefore, necessary to provide artificial illumination in all buildings to meet adequately the requirement when daylight is insufficient.

ARTIFICIAL LIGHT SOURCES

The most outstanding developments in artificial light sources during the past couple of years have been with gaseous conductor lamps. In this connection both mercury vapor and sodium vapor lamps should be mentioned; the latter because of its yellow-green monochromatic light, is confined to a great extent to outdoor applications. On the other hand, the recently developed mercury vapor lamp has a more general application, and is finding its way into steel mill interiors. It is available in the 250- and 400-watt sizes and with proper transformer or reactor auxiliary equipment can be used on either 115- or 230-volt alternating current circuits. These lamps have initial efficiencies of 30 and 40 lumens per watt respectively, and have a rated life of 2000 hours.

The lamps are tubular in shape, the 250-watt size being fitted with a standard medium screw base and the 400-watt size with a Mogul screw base. A mercury

lamp consists essentially of two main electrodes located at opposite ends of a glass tube in which the mercury that maintains the arc is vaporized. The tube contains a small amount of pure argon gas which is used as a conducting medium to facilitate the starting of the arc before the mercury is vaporized. In the 400-watt lamp the arc tube is enclosed in a larger tube in order to protect the arc from the effects of varying surrounding temperature. The 250-watt lamp has no such protecting tube around it, and if it is exposed to cooling draughts of air the vapor pressure will be reduced, which will cause the lamp to operate at a lower efficiency. However, if the lamp is used in a proper type of unit, such as a glassteel diffuser, adequate protection is provided.

The 250-watt lamp may be operated in any position, but the 400-watt lamp must be burned in a vertical position, usually base up, although lamps for base-down burning are available. In common with all arc sources, each lamp requires a ballast resistance or reactance to limit the current in order to prevent the arc from "running away with itself" and burning out the lead wires. Equipment for power factor correction is available and in general its use is to be recommended, but this is not essential in installations where consideration of the power factor is unimportant or where other means of general power factor correction are in use.

When the 250-watt lamp is started it takes from four to six minutes to reach full efficiency. With the 400-watt lamp full efficiency is reached in about twice this length of time. The lamps will not relight, after a current interruption, until they have cooled enough to reduce the vapor pressure sufficiently to allow the arc to strike again, which will occur automatically if the current is on. This may require from three to five minutes for the 250-watt lamp and from five to fifteen minutes for the 400-watt lamp, depending on conditions of operation. This characteristic of the lamps is likely to be a disadvantage in some applications, for example, in intermittent service where lamps are often switched on and off. However, where lamps are used continuously for extended periods, as they are in large work areas, no serious inconvenience because of this characteristic has been reported.

Under certain conditions a stroboscopic effect may be noticed under mercury vapor light, if it is not supplemented by any incandescent light. This means that a slight 60-cycle flicker can be seen when one is looking at moving objects. The explanation of this is that with each alternation of the current the light emitted falls to a low percentage of its normal value since the arc nearly goes out between alternations. This flicker is not particularly noticeable on the working plane and is not a serious objection to the lamp. With a three-phase lighting circuit, it can be practically eliminated by connecting adjacent rows of units on different phases.

The color of the light emitted by the mercury lamps has the characteristic mercury vapor line spectrum in contrast to the continuous spectrum of the incandescent lamp. This means that all the light from the mercury arc is represented by only a few bands which produce yellow, green, and blue light. Red is practically absent. The result is that although the light itself has a bluish-white cast, materials of certain colors such as the reds are not recognized, while yellows and greens are emphasized. Combined with the continuous spectrum of incandescent lamps, which is rich in red, the resultant light is a synthetic white, although by no means could it be considered a "color-matching" white because of the emphasis it gives yellows. However, if used in proper proportions the mercury-vapor-incandescent combination gives a cool white light which mixes well with natural daylight, and is very pleasant for use in factories, offices, and drafting rooms, where no occasion for accurate color discrimination of materials is presented.

Incandescent lamps are available for general lighting service (110-120 volt) in the same general types and sizes as have been used for several years; these include lamps from the 15 to the 1500-watt sizes. Researches are always in progress which continue to contribute valuable information toward the perfection of these lamps. All of the lower wattage general service lamps are regularly supplied with an inside-frosted finish. The larger sizes, that is 150- to 1500-watt inclusive, are supplied with clear, inside-frosted, or white bowl bulbs as desired.

For certain applications in steel plants, particularly on some of the machines, the lower wattage lamps are often subjected to vibration or to severe shocks. For those uses lamps of special design in the 50- and 100-watt sizes are available. They are designated as rough service lamps and vibration service lamps, depending upon which of these conditions exist. In many cases, however, the use of these special lamps may be avoided, either by the installation of vibration and shock-absorbing devices, or by redesigning the lighting system to eliminate the troublesome outlets.

Another incandescent lamp which was recently made generally available is the Bowl-Silvered lamp. This lamp is offered for use in indirect lighting systems for offices and drafting rooms. Also in low-ceiling machine and repair shop areas bowl-silvered lamps in enameled steel reflectors properly spaced will provide illumination with excellent diffusion and freedom from glare.

In the foregoing, it is noted that mercury vapor lamps are not only more efficient but also have a longer life than incandescent lamps. For example, the 400-watt size has about twice the lumon-per-watt output of the higher wattage incandescent lamps, and it lives twice as long. This does not mean that an economy will be found in immediately replacing all incandescent lamps with mercury vapor units because there are other factors which must be considered. The other factors are the conditions which establish investment costs in individual cases and the operating cost of the system. For example, if the cost of electrical energy is 2 cents or more per kw-hr., a few computations for a new lighting system may readily indicate an advantage in using a 400-watt mercury vapor system when its cost is compared with that for the production of an equal amount of light from a 750-watt Mazda lighting system. On the other hand, if the electrical energy rate averages less than 1¢ per kw-hr., the economy of using mercury vapor lamps will be greatly reduced and under some conditions will entirely disappear.

Again, if a lighting system employing 500-watt incandescent lamps on electric circuits loaded to capacity

is to be remodeled so that it will provide 50% more light, the 400-watt mercury vapor lamp can be installed without rewiring the plant. In contrast, if 750-watt incandescent lamps were to be used, the expense of a rewiring job would be involved. For such a condition, the 400-watt mercury vapor lamp should be seriously considered.

A majority of the steel mill buildings consist of long high bay sections. In these high bay sections the lighting units are often mounted 35 to 40 or more feet above the floor and spaced 40 to 50 feet apart without creating an uneven distribution of illumination. Such wide spacings require incandescent lamps of the 1500-watt sizes. In this case, if 400-watt High-Intensity Mercury Vapor lamps were used, it would require twice as many units, which would make such a system comparatively costly.

All the foregoing discussion on the comparative costs of mercury vapor and Mazda lamps is given to emphasize the need for careful consideration of each lighting system before making decisions regarding the type of light source to install. Aside from the economic analysis, the color quality of the light and the operating characteristics of the sources must be properly considered.

PRACTICAL INSTALLATIONS

Although a survey of present lighting conditions in steel mills would indicate many opportunities for improvement, there are several outstanding installations of well-lighted interiors. Fig. 3 shows the chipping department for a steel plant where the blooms and billots are carefully inspected and the flaws removed. In this department the outlets are mounted 35 feet above the floor and have an average spacing of approximately 14′ x 14′. Aluminum high bay reflectors equipped with 1000-watt lamps provide an average in service of about 30 footcandles of illumination. In this comfortably lighted room the workmen can carry on their inspection processes much more quickly and easily than would be possible under the 5 to 10 footcandles commonly found.

Fig. 4 shows a large machine shop area where rough machine work as well as some construction and assembly work is carried on. This shop is well lighted by prismatic glass high bay units mounted 45′ high on 20- x 40-foot centers with a few additional units over the center of the room and each equipped with a 1000-watt Mazda lamp. The resulting illumination averages about 16 footcandles.

Where fine machine shop work is being carried on, illumination of 50 to 100 footcandles is often desired at the tool point on the machine or work point on the bench. Lighting levels of this order can usually be most satisfactorily obtained from supplementary units, that is, local lighting units which supplement the general lighting for the shop. Fig. 5 illustrates a small machine shop having supplementary lighting which provides 120 footcandles on the lathe. This is in addition to the 15 footcandles of general illumination for the room. For best seeing conditions the supplementary footcandles should not exceed ten times those obtained from the general lighting system. This max-

Fig. 3—Inspecting blooms and billets and removing the flaws requires good lighting. In this chipping department an illumination level of 30 footcandles is supplied on the work area by 1000-watt lamps in aluminum high bay reflectors mounted 35 feet above the floor on 14- x 14-foot centers.

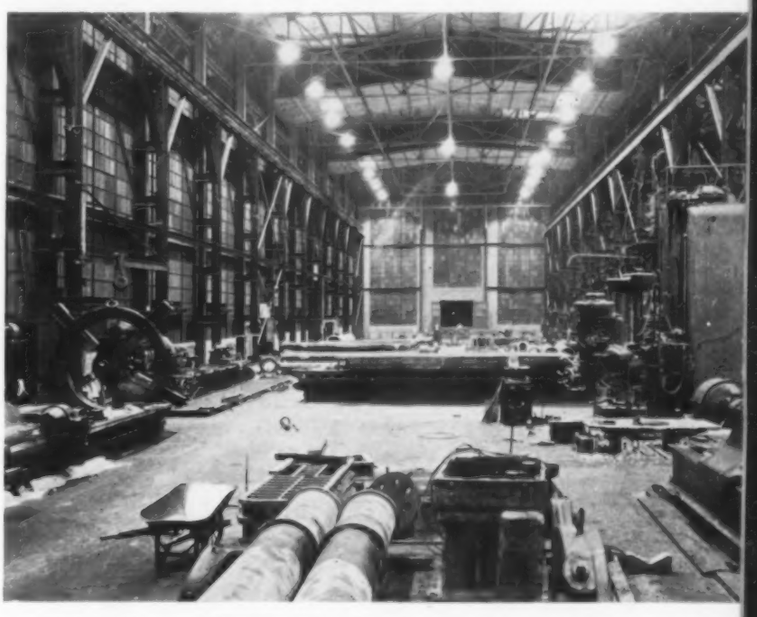

Fig. 4—Above—A large machine shop devoted to rough machining as well as some construction and assembly work. This shop is lighted to 16 footcandles by 1000-watt lamps in prismatic high bay reflectors mounted 45 feet high on 20- x 40-footcenters.

Fig. 5—Below—Many industrial tasks impose severe visual demands on the workers. Here a supplementary lighting unit provides the machinist with over 100 footcandles of additional illumination on the work area.

imum ratio is suggested in order to eliminate extreme contrasts between the work and the surroundings. Referring again to Fig. 5, the supplementary lighting equipment is provided with louvers not only to control the light carefully but also to eliminate any direct glare which might annoy a workman at an adjacent machine. This particular unit is known as the Miller Company Suplite, and employs a 150-watt lamp. It is located 5′ above the machine.

Fig. 6 shows a hot-finishing mill which is lighted from a combination of 750-watt Mazda and 400-watt mercury vapor lamps. The total wattage for the in-

Fig. 6—Illumination which approximates daylight color quality is provided in this hot-finishing mill by a combination of incandescent and mercury lamps. Four-hundred-watt mercury units were added to an installation of 500-watt incandescent lamps mounted 32′ above the floor on 20- x 25-foot centers. The total wattage of the incandescent system is about double that of the mercury system, but the light output of the two systems is approximately the same. Resulting illumination, 10 footcandles.

candescent system is approximately double that used for the mercury system, but in respect to light output the two systems are about equal. From this combination the resultant illumination approximates daylight in color quality. It averages close to 10 footcandles and is found to be very satisfactory for black plate rolling. This room is 75 feet wide with trusses on 20-foot spacings. The original lighting system consisted of three rows of high bay units spaced on 20- x 25-foot centers, mounted 32′ above the floor, and equipped with 500-watt Mazda lamps. The 400-watt mercury vapor lamps were recently added to the existing system and advantage taken not only of the increased illumination but also of the improved color quality which is possible from a combination system. This plan for providing better lighting would readily find application in relighting many departments throughout a steel mill. The adding of more lighting units to an existing system may, however, create the

Fig. 7—A well-lighted tinplate assorting department. The installation consists of one row of 750-watt Mazda lighting units over the storage and passage way on the left, and three rows of four hundred watt mercury units over the sorting tables. Inset shows a closeup of one of the 750 watt units.

feeling of too many individual units, or in some cases it may result in undesirable non-uniformity in the distribution of illumination.

Fig. 7 shows a tinplate assorting department which was relighted by completely redesigning the old system. The new lighting system as illustrated consists of one row of 750-watt Mazda lighting units over the storage and passageway on the left and three rows of 400-watt mercury vapor units over the sorting tables.

The room is 60 feet wide and lengthwise has trusses on 25-foot centers. The lighting units are on 12- x 25-foot spacings, mounted 32 feet above the inspection tables. The inset in the illustration shows the method of mounting the Ivanhoe RAS-400 mercury vapor units together with their auxiliary equipment. The illumination averages about 20 footcandles and is found to meet satisfactorily the requirements for tinplate sorting. Since the incandescent lamps in this room are located only along one side, the lighting obtained on the inspection tables is practically all of mercury vapor color quality which favorably is accepted by the tinplate inspectors. Although it was not anticipated that undesirable stroboscopic effect would be obtained from the lighting system, in order to eliminate it from this installation each of the three rows of mercury vapor units was placed on a different phase of the electrical distribution.

Fig. 8—An example of up-to-date lighting in a large industrial office. Approximately 20 footcandles of general illumination is supplied by 300-watt bowl-silvered lamps in silvray R.C.S. units mounted on 10- x 10-foot centers.

OFFICE LIGHTING

The lighting of industrial plant offices needs as much or perhaps more careful consideration than that required for manufacturing areas. Office work is almost entirely a visual job. Researches in the science of seeing have contributed a great deal of knowledge establishing the value of better lighting for our office spaces where the eyes are used continuously for long periods. Furthermore, practical demonstrations have indicated the economic value of better office lighting.

Figure 8 shows a general office for an industrial company. An even distribution of approximately 20 footcandles is obtained from totally indirect lighting units on 10- x 10-foot centers. The Silvray indirect units employing 300-watt bowl-silvered lamps provide illumination which is well diffused and free from glare. In many offices such as found throughout a steel plant it may not be practical to use lighting equipment of the indirect or semi-indirect type. In such cases it would be suggested that direct lighting units of white diffusing glass or glassteel diffusers be employed. In either case illumination of the order of 20 footcandles should be provided. Regarding white diffusing glass units, it is recommended that oversized glassware be employed in order to reduce the brightness of the unit. For existing installations in steel mill offices where white glass enclosing units are employed and found to be uncomfortably bright, a worth-while improvement can be made by equipping the units with large paper reflectors which shield the bright area of the diffusing globe.

Fig. 9—Type of disconnecting hanger used extensively by many large companies.

YARD LIGHTING

Floodlighting is a practical and economical solution to the problem of providing illumination for steel mill yards. There is really a three-fold need of such lighting. It enables work to be carried on after the sun has set. It helps protect the company against thievery and depreciation. It aids employees in parking their cars.

If protection is the prime consideration, the units should be so located that the watchman can see the intruder without himself being seen. This statement generally means that the lighting units are best located on the building, with their beams pointing toward particularly vulnerable locations.

Where the lighting is to be used for strictly utilitarian purposes, a different unit location is necessary in order to eliminate shadows. Thus the light should come from several directions instead of predominantly from one direction. Also, the units should be mounted high enough to prevent glare in the eyes of the workmen.

The lighting of outdoor active storage areas over which traveling cranes are operated is often satisfactorily obtained from equipment located on the crane construction framework. The practice is to mount angle reflectors as high as possible along each side of the construction frame and supplement them with two RLM Reflectors mounted underneath the traveling beam of the crane. Lamps of sufficient size to provide an average of at least one footcandle of illumination over the active area should be used in these equipments.

MAINTAINING THE LIGHTING SYSTEM

When a lighting system is installed which is capable of delivering an average of 10 footcandles of illumination under service conditions, it is false economy to let it depreciate to such an extent that this average level is not maintained. Lighting units of all types, regardless of their design, accumulate dust and dirt to some extent, and the work involved in cleaning then depends not only upon their design but also upon the method of supporting them. This is particularly true for all types which must be removed from the holder for cleaning or which are difficult to reach because of their location. In purchasing and installing lighting equipment, attention should be given to the ease with which the units may be removed for cleaning. For example, the cleaning of most industrial units would be much easier if the reflectors were suspended from hooks and equipped with separable plugs for the electrical connections. Such disconnecting devices would make it unnecessary for the maintenance man to carry his cleaning equipment up the stepladder. In fact, by having an extra lighting unit available, it is possible to carry the clean unit up the ladder and put it in place of the dirty one which is brought down to the floor for cleaning. This one becomes the clean unit for the next outlet, and so on. By use of this scheme one industrial plant reduced the cleaning cost per unit from 14 cents to 3 cents.

For lighting units which are difficult to reach, or hazardous to maintain because of their location, some form of disconnecting hangar with lowering cables is recommended. Figure 9 illustrates one of the well-known disconnecting hangars which has been extensively used by many large companies.

Many managers of industrial plants fully appreciate the value of keeping lighting units as clean as practical, but in general, cleaning schedules are greatly neglected. As a rule, all lighting units, regardless of whether they are in the mills or in the offices, should be cleaned at least once each month; shorter intervals than this should be adopted for those areas where considerable dust and smoke is found. It is only by means of a regularly established cleaning system that a well-designed lighting system can be maintained close to its initial efficiency.

DISCUSSION

PRESENTED BY

H. W. DALLAS, Philadelphia Electric Company, Chester, Pa.

H. R. PANCOAST, Delaware Power and Light Company, Wilmington, Delaware.

A. J. STANDING, Electrical Superintendent, Bethlehem Steel Company, Bethlehem, Pa.

R. W. CORWIN, Benjamin Electric Company, Philadelphia, Pa.

R. M. FULLER, Consulting Engineer, Riverton, N. J.

G. C. PHEFFER, Electrical Superintendent, Florence Pipe Foundry and Machine Company, Florence, N. J.

E. ANDERSON, Electrical Department, Bethlehem Steel Company, Sparrows Point, Md.

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F. O. SCHNURE, Superintendent, Electrical Department, Bethlehem Steel Company, Sparrows Point, Maryland.

H. W. Dallas: I'm very glad and very thankful for the privilege of being here tonight, because I knew it is inevitable that, sooner or later, I shall come into contact with some steel mill man who, if I don't look out, will know more than I do about illumination of steel mills and therefore I feel doubly grateful for the privilege of attending this meeting.

I believe that the high pressure mercury vapor lamp opens up a new field in the art and economics of industrial lighting.

H. R. Pancoast: I am grateful for the privilege of being here tonight. We do not have a steel mill territory, but do have one good-sized plant, the Worth Steel Company on our lines. We have done some experimental work with the high intensity mercury vapor lamp, and are convinced that it has real possibilities in the iron and steel industry. I appreciate what I have learned from Mr. Sturrock, and believe that all of us will have something to take home with us that we can use to very good advantage.

A. J. Standing: I came here expressly to learn something about lighting and I think I have. Whether I am going to be salesman enough to take it back with me and sell it, is another question as the economics of the problem are still quite important. We have some peculiar problems in the steel mill in the Bethlehem Plant. We have the Main Offices with some rather tempermental people involved. We have been making some interesting studies and have come in contact with some peculiar conditions, as a result I have gotten somewhat of a black name because when we go into a man's office after he has complained of the lights and find he has a glass plate on his desk we walk out saying "Until that glass plate is off the desk we cannot do business with you satisfactorily."

Another thing we have been criticizing is the condition of having the half glass partitions between the offices, so that those in one office are looking right into the lights in the next office. We have overcome some of that difficulty by having these glass partitions painted. We have made some studies on totally indirect light for the drafting department, using different types of ceiling paint, barreled sunlight and savolight, and materials of that character which, with the totally indirect lighting fixtures give in the neighborhood of 20 to 25 footcandles at the drafting table and are very satisfactory.

In the offices where we are using, in some cases direct illumination, and in other cases semi-indirect and totally indirect units, we have been experimenting with different types of ceiling finishes and we find that the condition of the ceiling and the cleanliness of the fixtures has a great deal to do with the efficiency of the light at the working platform.

In the general plant, we do not have special men available now to periodically clean the fixtures. The repairmen do that as often as we can force them to get at it in the offices, and in the main offices particularly there is a campaign now to clean fixtures.

Offices are one problem in our plant, while the mills, open hearths and foundries constitute another problem. As has been said, the mills are affected to a certain extent by the illumination resulting from the hot steel and their problem is complicated by the amount of dust and dirt and mill scale which accumulates over the walls and the steel material of the building which, naturally, absorbs the light and requires a greater intensity of direct illumination.

In the open hearths the problem is quite similar, because on one side of the furnace you have intense illumination from the furnace itself while on the pouring side you need very good light. We are using glass-lined fixtures on the pouring side and at the same time, we have spotlights on the side walls opposite to the furnace, which enable the ladle cranemen to properly place their hooks and to see that they are properly hooked on the ladle trunions. That, we feel, is a very vital safety problem.

In the foundries the problem is even worse than it is in either of the other two places because everything in the foundry is just as black as your hat, the crane runways, the walls and the material and everything. All we can hope to do there economically, is to give safe walking and moving light for the men and depend on immediate local light for the inspection of moulds, materials and operations pertaining to Foundry practice. We have gone into this at different times and studied at the foundry and it's a problem. I would like somebody to tell me just the right, economical lighting for steel and iron foundries.

In our general yard lighting we are swinging over more and more to flood lighting. By using steel tower construction, sixty-five feet and over, we find there is no objection on the part of the yard men to flood lighting, and it is increasing every day. The results have been quite satisfactory, so long as we keep them up.

Another problem, before we come to the inspection, is emergency lighting. By that I mean the lighting necessary on breakdown jobs. We are all steamed up on safety, and our safety is carefully taken care of on routine work, but when you come to an emergency breakdown, safety may be overlooked and many of the cases of accidents in emergency work and repair work are due to the lack of safe lighting. To take care of this we have built pipe frame stands, on which we mount flood lights, which are equipped with safety switches and portable cords so that they can quickly be delivered to an emergency job and give the men working on a broken pipe line or gas line, or whatever it is, safe, adequate light in which to get around, in otherwise very dark and dangerous conditions.

The last phase of lighting is this ever-present inspection proposition. Mr. Sturrock didn't mention the standard mercury tube light combined with incandescent lamps. Your Mr. Flounder, worked with me on that a couple of years ago, and our small bar inspection beds have a number of those units installed, on 25 cycle. There again you have that 25-cycle, 220 volts, or direct current 230 volts, to contend with, so that we are out of the picture on the high intensity lamps, but with this combination mercury tube lamp, by putting the incandescent lamps on direct current, and the mercury tube on 25-cycle, we arrived at a very satisfactory light, giving us from 15 to 20 foot candles on our bar inspection beds, with a type of light which showed up the hair crack flaws in very satisfactory manner, and the men claimed that their efficiency was not impaired at the later hours of the day when, previously, by three or four o'clock in the afternoon, the men complained of headache and trouble with their eyes which, naturally, resulted in poor inspection. I think we will continue this type of installation, as it seems to be very satisfactory.

I am very much interested in this paper and I appreciate the work involved in its preparation. I am particularly interested in the sight meter, but I hope this paper is not published where some of our office people can see the revised footcandle tables.

R. W. Corwin: I am very pleased to be here tonight, and I would like to echo something that Mr. Sturrock brought out with regard to maintenance; maybe I can add a thought to it. I believe it is good accepted practice to set up a cleaning schedule. It may be one will think two weeks about right, maybe someone else thinks a month would be about right, and on paper it's a mighty fine schedule. Now, economically, you can only designate rather cheap labor to carry out that maintenance project. The first time it comes upon the schedule it is taken care of, right on the dot and, if the job is hard, the second time on the two-weeks schedule may be probably two and a half. At the end of six months your cleaning schedule, because it is rather a difficult job and you've got cheap labor on it, is down to a basis of about every two months instead of every two weeks.

Mr. Sturrock has shown an easy method, with equipment they have available, which means that you can bring your unit down on the floor, and from a safety standpoint that is a very valuable point, but it is even more valuable because a cheaply paid mechanic or cheap labor such as you use for cleaning, can get it down on the floor and do the job easily and, therefore, *will* do the job as you have scheduled it to be done.

I find also that our experience proves that where you are using the dust-tight cover of glass on the bottom of the unit or the glass-steel diffuser, it is almost absolutely necessary to bring that down, for safety, to the floor for maintenance work. Therefore the use of easily detachable units or systems will certainly be the solution of your maintenance problem. And your maintenance problem means more than the fact that you are losing energy; because you are not getting the light that adds to the safety of your plant when intensities are what they should be.

E. Anderson: I have enjoyed the paper very much and wish to compliment the speaker on preparation of it. In laying out lighting at Sparrows Point, we have endeavored to work to a base of five foot-candles for general lighting. Of course installation and maintenance costs are a determining factor in a good many installations.

R. M. Fuller: I would like to ask Mr. Sturrock what the power factor of the mercury lamp is. I rather gathered that they do not have one hundred per cent power factor and therefore if you have any considerable installation of them, you have something of an economic and regulation problem involved in taking care of the poor power factor resulting from any considerable installation.

G. C. Pheffer: The question of "Lighting" is, I think, one of the most important items in the plant. It pays enormous dividends in increased production, safety, cleanliness and a better product, but it is the hardest job to sell management, because you cannot very well show in your statement a definite return on the investment. You may speak of power saved, but where power costs are one cent or less per K.W.H. it doesn't mean much.

There is one way that has been found effective in helping us to get the story of good lighting across, and that is to get the Superintendent of a shop that is suffering from losses due to spoiled work, or a drop in production, and show him how a better lighting job will help him to overcome some of his difficulties. You

will find in him a wonderful ally in getting the money to improve the lighting.

We have found this method very effective. After all, the superintendent of the shop in which you intend to install better lighting should have some voice in the matter of increasing his operating costs, and it is he who will show the increase of production.

Mr. Sturrock has in his very fine talk given us much food for thought. The high pressure mercury light which he has described is a very fine light. We recently installed one on trial in our machine shop. At first we met with a great deal of opposition to its use—some objected to the ghastly color it gave to their skin and some objected to the effect its rays might have on their health. However, after all objectors were pacified, we installed the high pressure mercury light over the worst objector's machine. This happened to be a lathe doing a very accurate job of turning a highly polished shaft. After the first night, it seemed every man in the shop wanted one of these lights over his machine. It does enable one to see much better. The one machine over which this light is installed is able to turn out a much better finished product than before. Mr. Sturrock spoke of office lighting and high intensity. We had in our engineering department 50-ft. candles, using a semi-indirect unit—good distribution, no shadows, but strange as it may seem we had plenty of complaints from the employees in this department. Their complaints were eye fatigue, after several minutes of work their eyes became watery and they had to stop work. This lighting system had been in use several years, and it was only recently that we began to get these complaints. A careful study revealed that a change had been made in the material being used in this department. Pencil tracing cloth was being used where previously ink tracing cloth had been used. The reflection from the pencil mark at this high intensity was apparently causing the trouble. We overcame the difficulty by using a silvered bowl light in this unit, thereby converting the lighting to an indirect system—a sacrifice of intensity but better diffusion at a very small cost.

One objection we have received to the unit which was described by Mr. Sturrock and which Mr. Sturrock I am sure will agree is a well-founded one—is the shroud or canopy over the opening in the reflector does not extend far enough over this opening. We have found that a small section of the luminous portion of the tube is visable between the shroud and the reflector and the light is so intense that it causes momentary blindness. This matter I am sure the manufacturers will overcome very easily.

As mentioned before this matter of good lighting is one of utmost importance to every one. It has been a pleasure and a privilege to hear one who is so able to talk on this subject of lighting as Mr. Sturrock, and I want to congratulate him on his very fine paper.

C. H. Grim: I have enjoyed the paper presented by Mr. Sturrock, also the questions and comments by the engineers of the iron and steel industry and representatives of lighting equipment manufacturers. This interchange of ideas proves very helpful to all in solving future lighting problems.

I am glad to hear that the iron and steel industry does not skimp on the use of K.W.H.'s for lighting.

N. C. Bye: Perhaps our experience will partially answer the request for information as to what happens on surges on power lines and the request for a voltage regulator. In our application of high pressure mercury vapor lamps, we have them on a circuit which is rather heavily loaded and every time we throw in cross the line start motors, the lamps go out. The peculiar thing about it is that not all go out each time, nor does the same one go out each time. This lamp outage results in a shut-down for about ten ot twelve minutes so there are periods of time where one light is going out and another coming on. Because of this we are running two separate lighting circuits, one with high pressure units and the other with standard incandescent units. I believe the shutting down of the lights is the result of momentary low voltage due to the power surges in the line. I would like to ask Mr. Sturrock if he has any information as to how close voltages have to be maintained on high pressure lamps to prevent this occurrence—that is, how far above and below can one go before encountering trouble.

Another question deals with smoke or haze conditions which are particularly bad in small mills and the application of a lamp to penetrate this smoke or haze. The incandescent lamp is not particuarly satisfactory and I wonder how light from a high pressure mercury lamp penetrates this in comparison to the light from an incandescent lamp.

A. T. Lukens: I think the speaker should be congratulated this evening for having brought out both the disadvantages as well as the advantages of this lamp. I believe that the future developments will probably minimize these disadvantages, but I think the speaker has probably gained at least one additional talking point. If these lamps were installed there wouldn't be any tendency for the men to take home the bulbs, anyway.

I wonder whether the efficiencies which were indicated include the reduction in over-all efficiencies due to the transformers. And I would also like to ask whether a separate transformer is necessary for each lamp. I am sure that these lamps hold great promise for the future and as the work on them is continued, they will still become more efficient and more desirable.

G. O. Van Artsdalen: I don't think I have anything to add. Mr. Bye has practically covered all of our problems with the high intensity units. Except for possibly one thing, and that is that we have attempted to use the standard foot candle meter in measuring foot candles obtained, and we find that we have to use the conversion tables, and we don't get the same number of foot candles for the lumens output that we do on the standard Mazda lamp. I would like to know just why.

E. L. Sholl: On receipt of this notice, which reads—"The Association of Iron & Steel Electrical Engineers is going to devote an evening to Modern Lighting Technique in Steel Mills," I made up my mind I wanted to be here, I am here, and, I do not regret it.

This has been a *very interesting* and *profitable evening* for anybody interested in *lighting* problems.

It has been my privilege to have called on electrical superintendents of steel mills for a number of years, and, as Mr. Dallas over here has said, "He was trying to keep ahead of them," I have been trying to keep up with them.

To help your understanding of what is on my mind, it is amusing, after having called on steel mill engineers, to get into a bakery, for example, where they will ask if you cannot save them *wattage*, when, as a matter of fact they are using 50 or 75-watt lamps on twenty foot centers. Fancy this, after being in a steel mill where they may consider a five hundred watt lamp sort of a pilot light.

We read about these high powered lamps, but, these men live with them and they know how they perform. I would like to ask a question right here, of Mr. Sturrock or any of these men—many of whom can answer the question; viz., Have you, in the use of these 1,000 and 1500 watt lamps, gotten away from the overheating difficulties of sockets and bases with the burning lamp temperatures combined with high room temperatures? Are we "out of the woods" on that, or must there be a change in the construction of the equipment that these lamps perform in?

R. B. Gray: I think there is one thing that has been touched on slightly and which is very important to anyone who has employees and that is *eye sight.* An employee may be very valuable to his firm and may be able to increase production and do better work which will bring increased dollars and cents for his firm if he is able to see well, but he may be an eye sight cripple starting out. By giving this man more efficient light, he will be able to bring dollars and cents in to the manufacturers' pockets sooner.

Then the question may arise about the amount of light needed where you have several shifts. Here you will have to take an average of light needed by the men working.

In prescribing light it is necessary to give the correct amount of light so that every one will benefit by its use.

Poor light is detrimental to the welfare and health of the employees, but by the use of good light everyone benefits.

R. W. Corwin: I would like to ask one question. There is, I believe, a history of some twenty thousand vapor units already in operation, and they have probably been installed sometime within the last year, the majority of them. Not that is not too many working hours, but it is still a very long period so that we may have a very definite understanding that the results are good from this lighting. In your reports from these various installations, are your outages averaging high enough so that that is really a worry from the standpoint of lamp outs, due to fluctuating voltages?

W. C. Kennedy: Mr. Standing made a remark about using a combination of mercury vapor lamps on a 25 cycle mill circuit with mazda lamps on direct current.

The forerunner of this new high intensity mercury light was the Cooper-Hewitt lamp which operated on direct current. I would like to ask if it is possible to make this high intensity mercury light operate on direct current also, thereby getting away from the flickering that is so prominent with the 25 cycle circuit?

G. J. Amelinck: I am more or less of an outlaw at this meeting. I don't have a large steel mill in my territory, but I have had several inquiries, although this light is new from textile mills, and especially from hosiery mills where light is quite an important part of their manufacturing problem. I think you will find the percentage of their total power requirements runs about 60 per cent power and about 40 per cent lighting. Now, in days gone by, if you mentioned to a hosiery knitter that you were going to take his seven or eight 60-watt droplights away from the bed of the hosiery machine you might as well pick up your hat and run because that was treason. But of the few mills that have changed, several of them to the mercury vapor lamp, the Cooper-Hewitt, their reaction was entirely opposite to what we expected. The knitters, after becoming accustomed to the Cooper-Hewitt lamps, swore by them and didn't want to go back to the Mazda lighting.

So I would like to ask Mr. Sturrock if in their research they have taken into account the value of this lamp for application to textile mills.

W. Sturrock: I have quite a long list of questions which I will try to answer. But before doing so, I want to express my gratitude for the kind remarks many of you have made about my paper. Although I didn't read it verbatim, I do have a complete paper on the subject and in it will be found answers to some of the questions that have been asked tonight.

The first question that I made note of referred to the use of mercury lamps on 25-cycle circuits. The difficulty encountered on 25-cycle current is with the ballast equipment. This equipment would be much larger and more costly than that now used on 60-cycle circuits. Furthermore, the stroboscopic effect would be quite a bit more pronounced. The general feeling of the manufacturers is that the advantage of mercury vapor lighting would be largely eliminated if the equipment were designed for 25-cycle operation. The cost of a motor generator converter to provide 60-cycle current from a 25-cycle supply is an item which must be charged against the cost of the lighting system, and from the remarks already made I would assume that the use of a motor generator converter is not an economical solution. This does limit the use of the mercury lamps in cases where you have 25-cycle current and no way of getting 60-cycle.

I am not very familiar with the sizes and types of voltage regulators. It is my understanding that suitable equipment is available for regulating the voltage in ordinary lighting circuits, either where you generate your own energy or where you purchase unregulated energy. In either case you should of course have the power and lighting circuits separated as far back as main transformer. Definite information on voltage regulators should be obtained from the manufacturers of such equipment.

As for lamp theft, that has always been a problem. It is a greater problem when we use great numbers of

low-wattage lamps, since those are the lamps that are usually used in the homes. Many devices have been available in the past, including theft-proof bases on the lamps, and lock-guard devices on sockets. The practice of putting the company's name on the lamp, stating that "This lamp has been stolen from—so and so—" is often resorted to. Bases with left-handed threads have also been used. I think, after all, the best solution to the whole problem is to locate as many of the lamps as possible out of reach of the employees, instead of close to the work; some of the new supplementary lighting units have been designed with that thought in mind, so that with their use it isn't so easy to reach the lamps.

With reference to a combination of the 50-inch Cooper-Hewitt lamps and incandescent lamps, this combination produces an illumination which is fairly white; and where good results have been obtained from that combination, my suggestion would be to continue with it. I don't see any reason for changing, unless you find that there is an advantage economically in using other light sources.

We have experienced no trouble whatever from vibration with mercury lamps. I don't know whether any of you have had any difficulty on that score, but if so we haven't learned about it.

In reply to the question regarding the current characteristics during the first few minutes after 400-watt mercury lamps are turned on, this current is of sufficient magnitude to become a factor which must be given consideration in designing and fusing the wiring circuits. When power factor correction equipment is used, the current at the start is about 75% above normal operating current, while without power factor correction equipment it is about 150% above normal. This current gradually drops off and reaches normal after 5 to 10 minutes.

It was asked how long the current has to be interrupted before the lamp goes out. An interruption of one or two cycles duration, that is, a small fraction of a second, will cause the lamp to go out. If the socket voltage suddenly drops 10% or more, the lamp will go out.

On the question of the penetration of the energy from mercury vapor lamps through fog and smoke, as far as we are able to determine, the lamps offer no advantage from that point of view.

The question was asked whether the efficiency in lumens per watt of the lamp includes the wattage consumed in the auxiliary equipment, and the answer to that is no. The efficiency is based on 400 watts for that size of lamp, while the total wattage, including the auxiliaries is between 420 and 460 watts. If you use a transformer along with a condenser to improve the power factor, it doesn't further increase the wattage.

The next question referred to the footcandle meter. For accurate readings under mercury vapor light all meters using light sensitive cells require a correction factor or a color filter. However, preliminary data on the cell used in the new G.E. Light Meter indicate that the error in reading mercury vapor lighting would probably not exceed plus or minus 10%.

A. J. Standing: Does the standard footcandle meter read low under mercury lighting?

W. Sturrock: Yes, some of the meters when used to measure mercury vapor illumination indicate a lower value than the actual footcandle level. I have used footcandle meters which required multiplying factors ranging from 1.2 to 1.4 in order to get a correct value.

The next question I have here refers to loose bases on 1500-watt lamps. We did have trouble with loose bases and I think we have pretty well overcome that with what is known as the new mechanical base. By that, I mean that our high-wattage lamps are now made so that there are depressions moulded into the glass bulb. When the brass base is put on the bulb, sections of the metal are pressed into those depressions, and the base is mechanically held on to the glass. A few years ago high-wattage lamps were made with the bases cemented on; the new method overcomes any difficulty with loose bases that you may have had in previous years.

R. W. Corwin: I believe there were tests made a matter of some seven or eight years ago at Nela Park which showed that by having a unit ventilated at the top you carried your hot air current to the base of the base of the lamp or the socket so you had more heat built up there than if you built the unit closed, and from that time I believe a majority of manufacturers have done away with ventilating hoods as a result of those tests.

W. Sturrock: That is true to a certain extent; but we do still have to ventilate certain units, for instance, the mercury vapor unit requires some ventilation. I don't know just the nature of your trouble. Do you think that with the new mechanical base you still have loose bases because of the temperature at the socket?

A. J. Standing: Just while you are on that point, I might say we do have considerable difficulty with 1000- and 1500-watt lamps, with the sockets overheating, particularly on the units which have the glass-enclosed plate at the bottom. The sockets fail and the lead-in wires melt, in some cases. In some locations of the plant we have repeated cases of trouble from that.

W. Sturrock: Someone asked the question whether our experience so far with the new mercury vapor lamps indicates a high percentage of outages. The answer to that is no. We have had very few outages. The greatest trouble is that the lamps continue to burn after their economical production of light has ceased. Our laboratory tests indicate that at 70% life, that is, at the end of 1400 hours of burning, the lamps have depreciated to about 8370 lumen output. They have a rated life of 2000 hours and present information indicates that they will live somewhat longer; however, their use beyond the 2000-hour burning period is economically questionable.

Mercury vapor lamps of the 400- and 250-watt sizes could be made for D.C. operation, but the starting of the arc would require higher voltage, and the ballast loss would be far greater than for A.C. The long gap of the low pressure Cooper-Hewitt lamps always requires special auxiliary equipment (readily redesigned

for D.C.) to furnish the several thousand volt starting "kick". The short gap and improved construction of the new lamps give simplified, reliable starting direct from the *peak* voltage available from 150-volt A.C. This voltage can readily be obtained on 115-volt A.C. circuits by using a transformer, but for direct current circuits the energy supply would have to be something greater than 150 volts which means 220 volts. On 220-volt circuits, the energy loss in the resistance ballast for D.C. is considerably greater than that for a reactance ballast on A.C. circuits.

I have a note here about textile mills. I didn't quite understand the question and I wonder if the gentleman will repeat it again.

G. J. Amelinck: I asked the question whether you had had any experience in these kinds of installations in textile mills, whether they can be adapted—if these gentlemen don't mind deviating a little bit from the subject of immediate interest to them. We have principally been talking about steel mills, but we have recently had inquiries from textile mills about these high pressure lamps.

W. Sturrock: I see no reason why they shouldn't be applicable in textile mills in the same way they are in other plants.

G. J. Amelinck: Well, I was wondering whether the color feature would be involved there.

W. Sturrock: Yes, it would be involved, but I know of many textile mills where for a long time mercury vapor lamps have been used in departments where color discrimination is not important.

Now, I believe, Mr. Chairman, that covers the questions, as best I could, any way.

R. M. Fuller: Mr. Chairman, I don't think Mr. Sturrock purposely passed my question by, but I asked the question about power factor.

W. Sturrock: Oh, I'm sorry; I have that question here, too. I don't know how I missed that. The power factor for the 400-watt lamp is 65 per cent. With the power factor correcting equipment, it goes up to 90 to 95 per cent.

The power factor for the 250-watt lamp is about 50 per cent, and with the special power factor correcting equipment it can be raised to 85 to 90 per cent.

A. J. Standing: May I ask an additional question? I am interested in these new high pressure lamps and in making a trial installation, for which we'll have to provide ourselves, with a 60-cycle M.G. set, which is the more economical voltage, 110 or 220? I see you supply them in either voltage, for putting in an outfit; which should we put in, 220 or 110? In other words, is it cheaper for you to come down from 220 to the lamp voltage, or to go up from 110?

W. Sturrock: It probably would be cheaper on the 220-volt circuit, because the overall energy consumption would be from 420 to 430 watts, whereas on a 115-volt circuit the overall energy consumption would be from 430-460 watts. Thus the light will cost slightly less when the lamps are operated on 220-volt circuits.

A. J. Standing: What mounting heights would you recommend?

W. Sturrock: The mounting height of lighting units is usually determined by physical considerations in the interior. For interiors having comparatively low ceilings it is general practive to locate the lighting units as high as possible as this will permit wider spacings between outlets and hence a minimum number of units.

A. J. Standing: Yes, I appreciate that, but our high units, incandescents, are in the neighborhood of 35 to 40 feet.

W. Sturrock: Then your spacing distance would depend entirely upon the illumination you want.

A. J. Standing: Yes, but the mounting height is fixed in most of our building, because the cranes travel underneath them, regulating the placing of the lamps.

W. Sturrock: Then the answer would depend on how many footcandles you want, and you would place the units at the proper spacing distances to give you the desired lumens per square foot. With a 45-foot mounting height, you can place the units at least 50 feet apart, if you want to, and still provide an even distribution of illumination over the working area. However, that wide a spacing would be entirely too great, I should think, for most of your work area, unless lamps larger than the regular 1500-watt size were used, because the resulting illumination would not be very high.

F. O. Schnure: Gentlemen, I can subscribe to Mr. Sturrock's levels of illumination, because I believe it is quite necessary in a good many cases. But in subscribing to them, we must of course scrutinize the situation very carefully because the wiring and power represents an added production cost. I would roughly estimate that lighting, in our plant at Sparrows Point, costs us $75,000, a year, on the present levels of illumination, of which possibly $20,000 are for lamps that are replaced during the year and the balance represents power and fixture replacement.

Nevertheless, we have practically doubled our illumination during the last ten years. In the Blooming Mills, the other day, in checking the lighting, we found not much over two or three foot candles but so long as the hot steel keeps going through the Mill, very little more is needed, excepting on repair jobs and we have more or less solved that problem by suspending fairly good illumination from the cranes.

Now there are two things that I would like to secure from the lighting industry. Of course, most of the steel industry is served by 25 cycle current and with very slight chances of getting 60 cycle power. We would like to use some of these mercury units and we would like to get from you, Mr. Sturrock, a small 25 cycle to 60 cycle converter that is not too expensive. The worst evil we find in lighting our steel mills, which spread over a large area, is voltage drop. We also need another device from the electric companies, and that is a cheap voltage regulator, of 25 to 50 KVA

(Please turn to bottom of next page)

THE ENGINEER

IN THE

STEEL INDUSTRY

By W. L. BATT*
President American Society
of Mechanical Engineers

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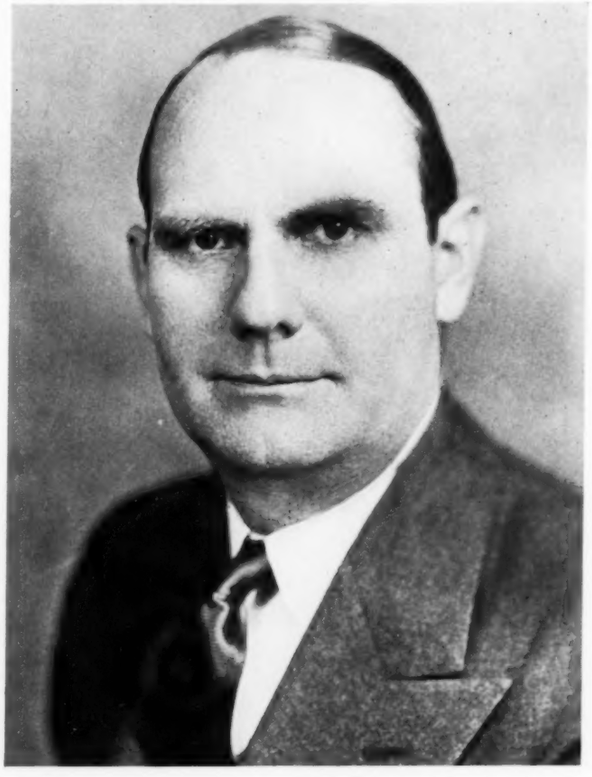
▲ THE COMING fifty years promise more new and difficult problems for the engineer than the last fifty, in spite of the tremendous technical accomplishments of that period. It is peculiarly true that engineering, of all the professions, is one which, by its very performance tends toward a self perpetuating expansion. There is literally no end to the consequences, material and social, of an engineer's work and this is particularly true where so much of his work today involves the human element. A new machine or a new process may be developed by the engineer to do a certain thing better or cheaper, but in its operation it may exert large and important incidental influences on the economic existence of many human beings. These indirect influences, unintentional though they may be, can actually overshadow the significance of the machine or process itself.

It is a natural result, therefore, that society is becoming increasingly concerned with the work of the engineer. As ridiculous as it may seem to us in the profession, there are, even today, a surprisingly large number of people who are not entirely clear in their minds as to the labor-saving work of the engineer and its relation to the serious problem of unemployment. Certainly it behooves the profession to speak with the utmost of force and clarity on this much misunderstood question. It is indeed fortunate that there exist in the steel field, agencies through which this can be done effectively. Amongst these The Association of Iron and Steel Engineers is outstanding. Founded particularly to consider the electrical engineering problems in the steel mill, its membership has broadened to the point where it is now equipped to look more generally at all engineering in the iron and steel field. With this larger view will go a correspondingly larger responsibility, not alone to the membership of the Society, but to the industry which it is serving.

The American Society of Mechanical Engineers, as the oldest professional society in this country in the field of mechanical engineering, will be vitally interested in the success of this Association and will be anxious to collaborate in any joint movements for the advancement of the work of the profession in the Iron and Steel field.



W. L. BATT

STEEL MILL LIGHTING

(Continued from page 13)

capacity that can be installed at load centers to maintain a constant voltage. It is a problem to get the proper voltage to the lamp. In a power system, supporting a 70,000 K.W. load of heavy mill units, there are necessarily quite a good many dips in voltage and transformer taps must be set so that the voltage won't be too high on light load and burn the lamps out, consequently, on periods of heavy load, low voltage and poor efficiency on lamps is experienced.

I was told the other day, of an installation of 800 mercury units in a mid-west sheet mill which operated 8,000 hours with only 15 burnouts. Certainly a very good record for mercury lamps.

The mill office lighting is a problem. We have found, however, that just painting the office increased the lighting efficiency one hundred percent. Previously, we had ten foot candles and after painting the office, we had 20 foot candles. Then the fixtures were cleaned —and they didn't seem so dirty—but we got five foot candles more out of the lights. Lighting is an interesting problem.

POURING PIT REFRACTORIES

THEIR EFFECT ON ALLOY STEEL QUALITY

By E. E. CALLINAN, Refractories Engineer
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Paper presented before the Ohio Ceramic Industries Association, at Columbus, Ohio, May 28, 1936

▲ THE IMPORTANCE of factors affecting pouring and teeming conditions in alloy steel production has drawn attention to the refractories used in these operations. Much may be done to minimize the chances of ruining heats of steel by the proper selection and use of pouring refractories. Refractory inclusions, originating from the furnace, spout, ladle, or mold will cause low cutter life and high tooling cost in the production of machined parts. Inclusions will also cause lines of weakness or stress in the product which may result in failure in service. As a result, steel producers are studying this problem, and with the cooperation of the refractories manufacturers have gone far in overcoming its worst phases.

EFFECT ON STEEL QUALITY AND POURING PRACTICE

Molten slag and metal attack the refractories exposed to them chemically (corrosion) and by mechanical action (erosion). The materials so exposed must therefore have not only ample refractory value but also the correct physical and chemical properties, to some extent at the expense of the refractory value.

Probably the greatest action occurs in the ladle, because of the violent impact at the start of tapping, the turbulent currents and splashing, and the sudden heat shock. Ladle design has a very definite effect on the life and utility of the ladle refractories, and any change in design must be considered in the light of the effects it will have on the slag and steel and on general teeming conditions.

Thinning of a refractory is influenced by the chemical properies of the slag and steel, their temperatures, and the time the steel remains in the ladle. Much of this refractory material rises through the steel and enters the slag, but some may be trapped in the steel and poured into the molds. The greatest erosion and contamination by refractory material undoubtedly occurs at the ladle nozzle. Here there is a combination of high velocity, a high pressure generated by the ferrostatic head and a large contact area per volume of steel. Design plays an important part here since it helps to control velocity, temperature and pressure.

In teeming, the mold hot top and plug may be subjected to severe impact and sudden temperature change. Solidification of the metal occurs rather rapidly at the bottom and sides of the mold because of its high heat conductivity, thus giving included particles little time to rise out of the metal.

Alloy steel producers are more concerned with the quality of their steel as affected by refractories than they are with refractory service life and cost per ton.

LADLE BRICK

Most present day ladle brick have a P. C. E. value of cone 23 (2840°F). Generally they are made of rather siliceous clays, a typical chemical analysis of a ladle brick showing

66%	SiO
25%	Al_2O_3
4.5	Iron & Titanium oxides
.4%	CaO

the remainder consisting mainly of magnesium, sodium and potassium oxides. Maximum firing temperature is about cone 5 (2201°F), firing treatment being closely controlled and progessing at a very slow rate, being of more than usual importance in producing satisfactory ware. The fired brick are quite hard and dense, having a water absorption of 7%—9%. However, the brick do not appear to be highly vitrified. These properties are essential in preventing penetration and fluxing action of slag and steel.

Theoretically a 65% silica fireclay brick is entirely unsuited for basic steel ladles. A basic brick would be better. However, magnesite brick and basic or neutral rammed-in linings have not been fully successful as due to their higher heat conductivity they tend to form a skull in the ladle. They also spall, while the author has never observed any signs of spalling of a regular ladle brick which has been entirely covered with slag or steel. The fireclay ladle brick seems to slough off as a thin layer during each pour, the resulting surface being smooth and evenly eroded.

A regular first quality fire brick does not give as satisfactory service as does the more siliceous ladle brick. It seems to wear more rapidly, probably because of its higher porosity and lesser degree of vitrification, and tends to "peel off", the slag adhering to it and pulling off a thin layer of the uncontaminated brick. Breaks occur around the large grog grains. This may be explained by the fact that frequently the grog used in the brick has been calcined to a temperature only sufficient to eliminate shrinkage at the firing temperature. On exceeding this temperature under

actual service conditions, further shrinkage of the grog occurs and it pulls away from the clay. This produces a zone of weakness and allows the turbulent metal currents to carry away the grains, thus creating potential inclusions.

Good ladle lining practice calls for uniform sized brick, medium thin, tight joints and proper use of such shapes as wedges and arches. Some operators have noted that the use of high temperature cement in place of ordinary fireclay for laying the brick has resulted in as much as a 10% increase in ladle lining life. This has also been efficacious in reducing the amounts of fireclay-type inclusions in the steel.

NOZZLES

P. C. E. values of clay nozzles may range from cone 18 (2714°F) to cone 30 (3092°F), cone 18 nozzle having a softening point around 2400°F. Most nozzles appear to consist of clay and a rather small percentage of medium fine grog. They have a water absorption of about 7%. Cursory microscopic examination does not show evidence of high vitrification but does disclose rather considerable amounts of free quartz well distributed in the clay substance. Hard-burned nozzles and sleeves are rejected by most steel plants since they show greater tendency to crack and spall in service. Care must be exercised during the drying and firing treatments that no warpage or deformation occurs, since an imperfectly shaped nozzle may directly affect the quality of the steel which passes through it.

The successful teeming of a heat of steel depends greatly on the nozzle, which has two main functions: (1) to act as a seat for the stopper head in shutting off the flow of metal from the ladle. (2) To be an outlet for and to control the character and velocity of the stream of metal.

If a clay-graphite stopper head is used, examination after teeming will show that it has closely retained its original shape, while the nozzle will disclose that the stopper head has been pushing into it and that some of it has been washed out by the steel. The nozzle is in a pyro-plastic condition and as long as it does not deform or flow too much as a result of the temperature or the fluxing action taking place, this plastic condition is desired in order to retain a good shut-off. A rather delicate balance must be maintained between temperature, fluxing action, stopper and nozzle. If the steel is either too hot or too cold, sticking may result. This would be especially true if the stopper head were clay. Best results are obtained when the two pieces do not have the same softening point.

Sometimes only a partial shut-off is obtained and the steel slowly dribbles through the nozzle. This may be due to faulty design of nozzle, stopper, or nozzle well, cracking of the nozzle, excessive erosion, insufficient plastic deformation of the nozzle to allow the head to reform the seat, or formation of a skull in the nozzle well. It is essential that there be good initial contact between the head and nozzle. Both pieces must be closely inspected before and after being set in the ladle. In some cases faulty nozzles may be ground by specially shaped cutting wheel so as to make a perfect seating area. If the interior is softer than the surface skin the grinding may expose this softer interior and produce teeming difficulties, making it essential that the nozzle be fired correctly.

The nozzle must be so set in the ladle that the hole will be absolutely vertical. If not, the stream will hit the side of the mold before it reaches the bottom. The bottom surface of the nozzle tip must be exactly perpendicular to the nozzle hole, for otherwise the stream will be thrown to one side or may spray. Such conditions will decrease mold life and result in faulty ingot surface, for steel hitting or spraying on the mold sides and freezing before the metal in the mold can reach it will tend to produce scabs on the ingot surface, thereby increasing chipping costs and sometimes causing rolling difficulties. The original diameter of the nozzle hole and its variations in size as it is eroded by the steel is of considerable importance for the same reasons.

Graphite nozzles with clay stopper heads and magnesite nozzles have not been used to any large extent. Magnesite, due to its higher heat conductivity, may develop a skull in the nozzle well. It also exhibits a tendency to build up and decrease the size of the opening.

Timken 100 ton electric furnace being tapped. Ill advised application of refractories may ruin the best of steel.

SLEEVES

P. C. E. values of sleeves will vary from cone 26 (2894°F) to cone 29 (2975°F). Usually they are more refractory than nozzles and have a higher water absorption value, from 9% to 12%. This may be due to the fact that they appear to contain a larger percentage of coarse grains.

The stopper rod upon which the sleeves are fitted acts as an arm to control the stopper head and also as a heat conductor in removing heat from the stopper head, metal bolt, and pin assembly parts. Sleeve brick protect the rod from the slag and steel and insulate it sufficiently to allow heat to flow up through it from the stopper. As the sleeves become thinner, this cooling effect is decreased, hence it is desired to

prevent them from fluxing, not only to help prevent the formation of inclusions but also to retain the maximum insulating effect.

Sleeves are joined with a high fusion, low shrinkage, flint base clay and must be handled carefully to avoid cracking at the joints. Quite often an air-setting chrome cement is used to bond the bottom sleeve to the stopper head and in some cases air setting fireclay cement is used in the sleeve joints. If this is done, the cement must not contact the rod and bond the sleeve to it because the sleeves expand approximately $\frac{1}{16}$" to $\frac{1}{8}$" per foot and adherence to the rod may cause the joints to break.

HOT TOPS

Required qualities of a hot top include: (1) Maximum resistance to cracking from heat shock. (2) Resistance to attack by steel. (3) Accurate size and proper design. (4) Insulating value. (5) Freedom from materials which will produce a gas when the hot top is heated by the metal. (6) Light weight for easy handling.

Hot tops are usually made by extruding horizontally from an auger machine or by the sewer pipe press method and fired to about 2000°F. After firing they usually have a water absorption value of 8%—11% and a P. C. E. value ranging from cone 18 (2714°F) to cone 28 (2948°F). As the bottom edge of the hot top is partially immersed in the steel the refractoriness, fluxing resistance, and surface condition are quite important. It is desirable that this edge be smooth so that a dense, smooth, minimum surface area will be exposed to the steel.

A hot top for a 19" round mold will weigh approximately 110 pounds. Recently, light weight tops, about 70-75 lbs., have been made by the introduction of coal, sawdust, or other materials which will be burned out during the firing operation. These reduce handling expenses and have a better effect on piping since they are better heat insulators and have lower heat capacity. Such tops will have a tendency to stick to the steel if open pores are present on the inner surface.

Tapered cast iron tops lined with firebrick or insulating fire brick are now being rather widely used. The taper reduces the amount of steel in the top from 10 to 15%, and being better insulators, they are more efficient in reducing piping. The brick lining is coated with a special graphite base refractory slurry to prevent steel penetration and to better allow them to be removed from the ingot. These tops are performing satisfactorily both from the standpoint of steel quality and of costs.

CLAY PLUGS

Clay plugs have a P. C. E. value ranging from cone 23 (2840°F) to cone 28 (2948°F), absorption varying from 7% to 10%. They are made of a clay grog mixture and hard fired. However, they must not be too highly vitrified or a shell of material will break off when the metal stream strikes them, and inclusions may result. They must be accurately sized so as to make a good seal. Surfaces must be smooth with no rough edges, fins, or loose sand and the firing or forming treatment must not develop a skin or laminations which will spall off. When fireclay inclusions are found in steel quite often they may be concentrated in the lower end of the ingot. Hence it is believed that faulty plugs are one of the chief sources of inclusions.

A string of ingot molds with the latest type of permanent metal hot tops can be seen at the extreme right of this view of the pouring aisle of the Timken Steel and Tube Company.

Various schemes have been tried to render plugs more serviceable. The upper edge has been rounded to reduce chipping. The top has been dished out to reduce the erosion by the metal stream. They also have been capped with sheet metal, either by forming the sheet over the plug or by simply placing a piece of sheet steel over the plug. The steel cap prevents a good tight seal, while the loose plate will be washed away as soon as the stream hits it. Experiments have been made with plugs having a metal plate fastened to them, which eliminates the two undesirable features previously described. These seem to offer very satisfactory results as the plate remains in place and the plug is not fluxed or spalled.

CONCLUSION

Much work still remains to be done in solving the problem of non-metallic inclusions. This is going forward in the laboratories of steel plants and refractories manufacturers and important advances are being made. Steel producers are constantly seeking means of improving the quality of their product and particular attention is being centered on the broad subject of refractories, embracing furnace linings as well as pouring pit materials. The constant advance in the production of high quality alloy steels and the rapidly increasing use of these steels brings new problems which must be solved and The Timken Steel & Tube Company is glad to cooperate with refractories manufacturers in the effort to give steel users the best possible steel.

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M. E. WILCOX, Superintendent, Fuels Department, National Tube Company, Lorain, Ohio.
E. C. MCDONALD, Combustion Engineer, Republic Steel Corporation, 3100 E. 45th St., Cleveland, Ohio.
W. H. FLANAGAN, Special Engineer, Carnegie-Illinois Steel Corporation, Pittsburgh, Pa.
G. M. COUGHLIN, Combustion Engineer, American Rolling Mill Company, Ashland, Ky.
C. H. VERWOLT, Works Engineer, Wheeling Steel Corporation, Yorkville, Ohio.
J. G. MCKINLEY, Vice President, Equitable Gas Company, Pittsburgh, Pa.
A. M. TREADWELL, Cost Engineer, Sharon Steel Corporation, Sharon, Pa.

Steam Generation and Utilization Section

CHAIRMAN: C. H. HUNT, Assistant to President, Weirton Steel Company, Weirton, W. Va.
J. B. CRANE, District Manager, Combustion Engineering Corporation, Pittsburgh, Pa.
R. F. CHAFFIN, Superintendent, Electric and Steam Departments, Pittsburgh Crucible Steel Company, Midland, Pa.
J. W. JONES, Steam Engineer, Wheeling Steel Corporation, Portsmouth, Ohio.
C. H. WILLIAMS, Steam Engineer, Carnegie-Illinois Steel Corporation, Youngstown, Ohio.
E. P. WINTERS, Power Engineer, Sloss Sheffield Steel & Iron Company, Birmingham, Ala.
G. W. KERR, Steam Engineer, Bethlehem Steel Company, Johnstown, Pa.
W. T. MCCULLOUGH, JR., District Manager, Babcock & Wilcox Company, Pittsburgh, Pa.
A. G. WITTING, Chief Engineer, Carnegie-Illinois Steel Corporation, Gary, Ind.

LUBRICATION ENGINEERING DIVISION

ENGINEERING SECTION DIRECTOR: C. C. PECU, Lubrication Engineer, Bethlehem Steel Company, Lackawanna, N. Y.
SECRETARY: F. J. THOMAS, Chief Lubrication Engineer, Republic Steel Corporation, Cleveland, Ohio.

Lubrication Application Section

CHAIRMAN: F. L. GRAY, Lubrication Engineer, Carnegie-Illinois Steel Corporation, Gary, Ind.
A. D. ADAMS, Assistant Superintendent, Spang Chalfant & Company, Inc., Ambridge, Pa.
H. J. MERCER, Lubrication Engineer, Youngstown Sheet & Tube Company, Youngstown, Ohio.
J. A. BURG, Mechanical Engineer, Carnegie-Illinois Steel Corporation, Munhall, Pa.
J. M. HUSHER, General Master Mechanic, Pittsburgh Steel Company, Monessen, Pa.
J. F. PELLY, Lubrication Engineer, Bethlehem Steel Company, Bethlehem, Pa.
C. W. PHILLIPS, Master Mechanic, Republic Steel Corporation, Warren, Ohio.
S. S. ROBERTS, Lubrication Engineer, Carnegie-Illinois Steel Corporation, Homestead, Pa.
H. G. GIBSON, Chief Engineer, McKeesport Tin Plate Company, McKeesport, Pa.
H. R. GILCHRIST, Lubrication Engineer, Carnegie-Illinois Steel Corporation, Youngstown, Ohio.
S. W. STAUFFER, Millwright, Jones & Laughlin Steel Corporation, Aliquippa, Pa.
T. R. MOXLEY, General Master Mechanic, Wheeling Steel Corporation, Steubenville, Ohio.

Device and Lubricant Section

CHAIRMAN: H. F. MARTIN, General Master Mechanic, Jones & Laughlin Steel Corporation, Aliquippa, Pa.
A. J. JENNINGS, Vice President, Farval Corporation, Cleveland, Ohio.
W. D. HODSON, President, Hodson Corporation, Chicago, Ill.
MAURICE RESWICK, Engineer, Standard Oil Company of New Jersey, New York, N. Y.
V. J. NOLAN, District Manager, National Carbon Company, Inc., Pittsburgh, Pa.
J. GUY GRIFFITH, President, J. Guy Griffith Company, Pittsburgh, Pa.
C. W. STAFFORD, Sales Engineer, Pure Oil Company, Pittsburgh, Pa.
W. H. OLDACRE, Vice President, D. A. Stuart & Company, Chicago, Ill.
A. F. BREWER, Mechanical Engineer, The Texas Company, New York, N. Y.
H. F. HACKEDORN, Sales Manager, Lubrication Products Company, Cleveland, Ohio.
R. M. GORDON, President, R. M. Gordon & Company, Pittsburgh, Pa.
OLIVER SCHAUER, Sales Engineer, Keystone Lubricating Company, Pittsburgh, Pa.
JAMES GRAHAM, Lubrication Engineer, Universal Lubricating Company, Cleveland, Ohio.
L. P. TYLER, Technical Department, Socony-Vacuum Oil Company, Pittsburgh, Pa.
F. E. JACQUES, Lubrication Engineer, Sun Oil Company, Youngstown, Ohio.
E. J. HULL, President, Trabon Engineering Corporation, Cleveland, Ohio.
F. B. GODARD, Division Sales Manager, U. S. Graphite Company, Pittsburgh, Pa.
D. J. RICHARDS, Sales Manager, E. F. Houghton & Company, Pittsburgh, Pa.
H. E. PRYOR, Sales Engineer, Banfield Oil & Grease Company, Etna, Pa.
W. B. SHIRK, Engineer, Gulf Refining Company, Pittsburgh, Pa.
E. W. BEARDSLEY, Secretary and General Manager, The Ohio Grease Company, Loudonville, Ohio.
E. S. GLAUCH, Mechanical Engineer, Jos. Dixon Crucible Company, Jersey City, N. J.
J. F. HALL, Assistant Chief Engineer, Ironsides Company, Columbus, Ohio.
T. J. KAUFFELD, Division Sales Manager, DeLaval Separator Company, Pittsburgh, Pa.
N. M. KIENER, Sales Engineer, New York & New Jersey Lubricant Company, Cuyahoga Falls, Ohio.
H. G. MULLEN, Grease Sales Supervisor, Tidewater Oil Sales Corporation, New York, N. Y.
F. G. GRASSLE, Secretary, Hills-McCanna Company, Chicago, Ill.
WM. R. MAIZE, Sales Engineer, Sinclair Refining Company, Cleveland, Ohio.
C. E. SPERRY, Service Engineer, Detroit Lubricator Company, New York, N. Y.
R. G. SCHENCK, Fiske Bros. Refining Company, Pittsburgh, Pa.

MECHANICAL ENGINEERING DIVISION

ENGINEERING SECTION DIRECTOR: J. A. CLAUSS, Chief Engineer, Great Lakes Steel Corporation, Ecorse, Mich.
SECRETARY: R. S. SHOEMAKER, Superintendent, Rolling Mills, American Rolling Mill Company, Middletown, Ohio.

Welding Section

CHAIRMAN: G. A. HUGHES, Electrical Engineer, Truscon Steel Company, Youngstown, Ohio.
WM. JACKSON, Electrical Superintendent, Carnegie-Illinois Steel Corporation, Homestead, Pa.
H. A. WINNE, Manager, Mining and Metallurgical Sales, General Electric Company, Schenectady, N. Y.
H. E. GIBSON, Executive Vice President, Wellman Engineering Company, Cleveland, Ohio.
J. S. O'DONOVAN, Electrical Superintendent, Spang Chalfant & Company, Etna, Pa.
A. W. SONNEBORN, District Manager, Clark Controller Company, Detroit, Mich.
W. F. RIGGS, Electrical Superintendent, Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
D. I. BOHN, Electrical Engineer, Aluminum Company of America, Pittsburgh, Pa.
J. J. PARKS, General Superintendent, Steel & Tubes, Inc., Cleveland, Ohio.
A. F. DAVIS, Vice President, Lincoln Electric Company, Cleveland, Ohio.
WRAY DUDLEY, Electrical Superintendent, National Tube Company, McKeesport, Pa.

Rolling Mill Practice Section

CHAIRMAN: F. H. DYKE, Superintendent Blooming, Bar and Strip Mills, Wheeling Steel Corporation, Steubenville, Ohio.
A. E. MILLER, General Superintendent, Allegheny Steel Company, Brackenridge, Pa.
H. N. PENDLETON, Superintendent Skelp Mills, National Tube Company, McKeesport, Pa.
J. S. PASTORIUS, General Superintendent, Great Lakes Steel Corporation, Ecore, Mich.
WM. VAN TRIEST, Roll Designer, Carnegie-Illinois Steel Corporation, Duquesne, Pa.
J. A. BRUA, Superintendent Cold Strip Mills, Ford Motor Company, Detroit, Mich.
G. S. MICAN, Assistant Superintendent Slabbing and Plate Mills, Carnegie-Illinois Steel Corporation, Chicago, Ill.
P. H. KUTAR, Assistant General Superintendent Rolling Mills, Tata Iron & Steel Company, Jamshedpur, India.
J. H. VOHR, Superintendent Strip Mills, Granite City Steel Company, Granite City, Ill.
H. B. CONOVER, Assistant General Superintendent, Carnegie-Illinois Steel Corporation, Mingo Junction, Ohio.
C. L. MCGRANAHAN, Assistant General Superintendent, Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
STEPHEN BADLAM, Consulting Engineer, Pittsburgh, Pa.
F. E. FLYNN, General Superintendent, Republic Steel Corporation, Warren, Ohio.
F. L. ESTEP, Vice President, Perin Engineering Company, New York, N. Y.

Rolling Mill Practice Section—Continued

J. Gordon Gage, General Superintendent, American Rolling Mill Company, Butler, Pa.
C. H. Manion, Chief Engineer, Follansbee Bros. Company, Follansbee, W. Va.
S. Findlater, Manager, Development Department, National Tube Company, Pittsburgh, Pa.
K. H. McLaurin, General Superintendent, Carnegie-Illinois Steel Corporation, Duquesne, Pa.
W. R. Clark, General Works Manager, Bridgeport Brass Company, Bridgeport, Conn.
G. D. Boyd, Vice President, Wallingford Steel Company, Wallingford, Conn.
R. M. Hussey, Superintendent Rod and Wire Mills, Jones & Laughlin Steel Corporation, Aliquippa, Pa.
D. A. Keating, Chief Engineer, American Tube & Stamping Company, Bridgeport, Conn.
D. B. Geeseman, General Superintendent, Standard Tin Plate Company, Canonsburg, Pa.

Rolling Mill Equipment Section

Chairman: H. J. Baugh, Assistant General Superintendent Youngstown District, Carnegie-Illinois Steel Corporation, Youngstown, Ohio.
R. J. Wean, President, Wean Engineering Company, Warren, Ohio.
J. L. Young, Service Engineer, United Engineering & Foundry Company, Pittsburgh, Pa.
H. C. Funk, Chief Draftsman, E. W. Bliss Company, Salem, Ohio.
J. H. Kalberkamp, Chief Draftsman, Mesta Machine Company, Pittsburgh, Pa.
L. D. Smith, Vice President, Lewis Foundry & Machine Company, Pittsburgh, Pa.
J. R. Patterson, General Manager Sales, Mackintosh-Hemphill Company, Pittsburgh, Pa.
Austin Kuhns, Mechanical Engineer, Farrel-Birmingham Company, Buffalo, N. Y.
H. H. Wood, District Manager, Morgan Construction Company, Pittsburgh, Pa.
Q. S. Snyder, President, Pittsburgh Rolls Corporation, Pittsburgh, Pa.
E. Peterson, Chief Engineer, Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa.
F. H. Barnard, Sales Engineer, Morgan Engineering Company, Alliance, Ohio.
K. Feller, Manager, Schloemann Engineering Company, Pittsburgh, Pa.
A. E. Balke, Sales Engineer, Continental Roll & Steel Foundry Company, Pittsburgh, Pa.
Myron I. Arms, Vice President, Aetna Standard Engineering Company, Youngstown, Ohio.
H. S. Lamb, Vice President, Cold Metal Process Company, Youngstown, Ohio.
G. T. Ladd, President, Ladd Equipment Company, Pittsburgh, Pa.
S. R. Cox, Jr., District Manager, Morgan Engineering Company, Pittsburgh, Pa.

Special Bearing Section

Chairman: F. D. Egan, Electrical Superintendent, Bethlehem Steel Company, Lackawanna, N. Y.
S. M. Weckstein, Assistant Chief Engineer, Timken Roller Bearing Company, Canton, Ohio.
C. H. Thayer, Chief Engineer, Republic Steel Corporation, Cleveland, Ohio.
H. S. Ewart, Sales Engineer, Bantam Ball Bearing Company, Pittsburgh, Pa.
S. N. Roberts, Mechanical and Electrical Superintendent, Atlantic Steel Company, Atlanta, Ga.
G. Palmgren, Chief Engineer, SKF Industries, Inc., Philadelphia, Pa.
J. P. Quinn, Superintendent Cold Strip Department, Wheeling Steel Corporation, Steubenville, Ohio.
J. H. Hitchcock, Engineer, Morgan Construction Company, Worcester, Mass.
A. L. Milton, Chief Engineer, Wheeling Steel Corporation, Yorkville, Ohio.
S. Farrel, Sales Engineer, Rollway Bearing Company, Pittsburgh, Pa.
A. W. Soderberg, Chief Mechanical Engineer, Carnegie-Illinois Steel Corporation, Munhall, Pa.
J. M. Kelly, Sales Engineer, Hyatt Roller Bearing Company, Pittsburgh, Pa.
W. J. Phillips, Plant Engineer, Calumet Steel Company, Chicago Heights, Ill.
F. W. Voght, Sales Engineer, Jos. T. Ryerson & Company, Inc., Philadelphia, Pa.
Lee Mandeville, Chief Engineer, Kokomo Steel Company, Kokomo, Ind.
J. L. Wick, Jr., President, Falcon Bronze Company, Youngstown, Ohio.
T. French, Assistant Superintendent Mechanical Department, Youngstown, Sheet & Tube Company, Youngstown, Ohio.
H. F. Brenholts, Sales Engineer, Fafnir Bearing Company, Pittsburgh, Pa.
A. B. Lakely, General Engineer, Kingsbury Machine Company, Philadelphia, Pa.

Transportation and Material Handling Section

Chairman: A. W. Duncan, Chief Electrician, Weirton Steel Company, Weirton, W. Va.
Malcolm Nesbit, Sales Engineer, Automatic Transportation Company, Pittsburgh, Pa.
D. M. Petty, Superintendent Service Division, Bethlehem Steel Company, Bethlehem, Pa.
G. H. Criss, Sales Engineer, H. G. McCoy Co., Pittsburgh, Pa.
E. L. Rayson, Sales Engineer, Shaw Box Crane & Hoist Company, Pittsburgh, Pa.
J. K. Mahaffey, District Manager, Edison Storage Battery Company, Pittsburgh, Pa.
Harry Eastwood, Sales Engineer, Cutler Hammer, Inc., Cleveland, Ohio.
R. J. Geisler, District Manager, Ready Power Company, Chicago, Ill.
A. J. Dreyer, District Manager, Harnischfeger Corporation, Pittsburgh, Pa.
E. Drexler, Engineer, Schloemann Engineering Company, Pittsburgh, Pa.
P. H. Diver, Sales Manager, Ohio Electric Company, Cleveland, Ohio
L. N. Crissmann, Sales Engineer, Electric Storage Battery Company, Pittsburgh, Pa.
H. A. Fennerty, Vice President, Alliance Machine Company, Alliance, Ohio.
M. J. Van Leewen, Sales Engineer, Yale & Towne Manufacturing Company, Chicago, Ill.
F. H. Barnard, Sales Engineer, Morgan Engineering Company, Alliance, Ohio.
F. J. Wood, Chief Engineer, Goodman Manufacturing Company, Chicago, Ill.
A. J. Brown, Sales Engineer, Whiting Corporation, Chicago, Ill.
H. L. Wilcox, Assistant Chief Engineer, Electric Controller & Manufacturing Company, Cleveland, Ohio.
A. E. Rosenquist, Design Engineer, Carnegie-Illinois Steel Company, Duquesne, Pa.
C. H. Saiter, District Manager, Cleveland Crane & Engineering Company, Pittsburgh, Pa.
Sydney Buckley, Vice President, Shepard Niles Crane & Hoist Corporation, Montour Falls, New York.

Items of Interest

Alden C. Cummins has been appointed assistant manager of operations, Pittsburgh District, Carnegie-Illinois Steel Corporation. Mr. Cummins was first employed by the Duquesne Steel Works of the Carnegie Steel Company as an electrical draftsman in 1911, continuing with the company in various positions of responsibility until 1932, when he was

ALDEN C. CUMMINS

appointed assistant general superintendent of the Duquesne Works. In 1933 he was promoted to general superintendent, which position he held until his recent advancement. Mr. Cummins is a past president of the Association.

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King H. McLaurin, chief mechanical engineer, Duquesne Works, Carnegie-Illinois Steel Corporation, has been appointed to succeed Mr. Cummins as general superintendent. Mr. McLaurin started at the Duquesne Works in 1912, as a machinist in the blast furnace mechanical department. He advanced through the various grades to assistant master mechanic of that department, when he entered the services of the U. S. Army as 2nd Lieutenant in the Air Service, Aeronautics Technical Division, February, 1918 to April, 1919. On his return from military service he was made assistant master mechanic of the Duquesne Works. In 1931 he was promoted to master mechanic, and in 1932, to date, has been chief mechanical engineer. Mr. McLaurin is a graduate of Stevens Institute of Technology with the degree of mechanical engineer. He is also an active member of the association.

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Bennett M. Livezey, formerly superintendent of the By-Product Coke Plant of the Clairton Steel Works, Carnegie-Illinois Steel Corporation, has been appointed assistant general superintendent of that plant. Mr. Livezey was first employed by the Carnegie Company in the Steel Works Laboratory of the Clairton works in 1916. In 1920 he was made assistant chief chemist and in 1923 chief chemist. In 1926 he was made superintendent of the coke works, which position he held until his recent appointment.

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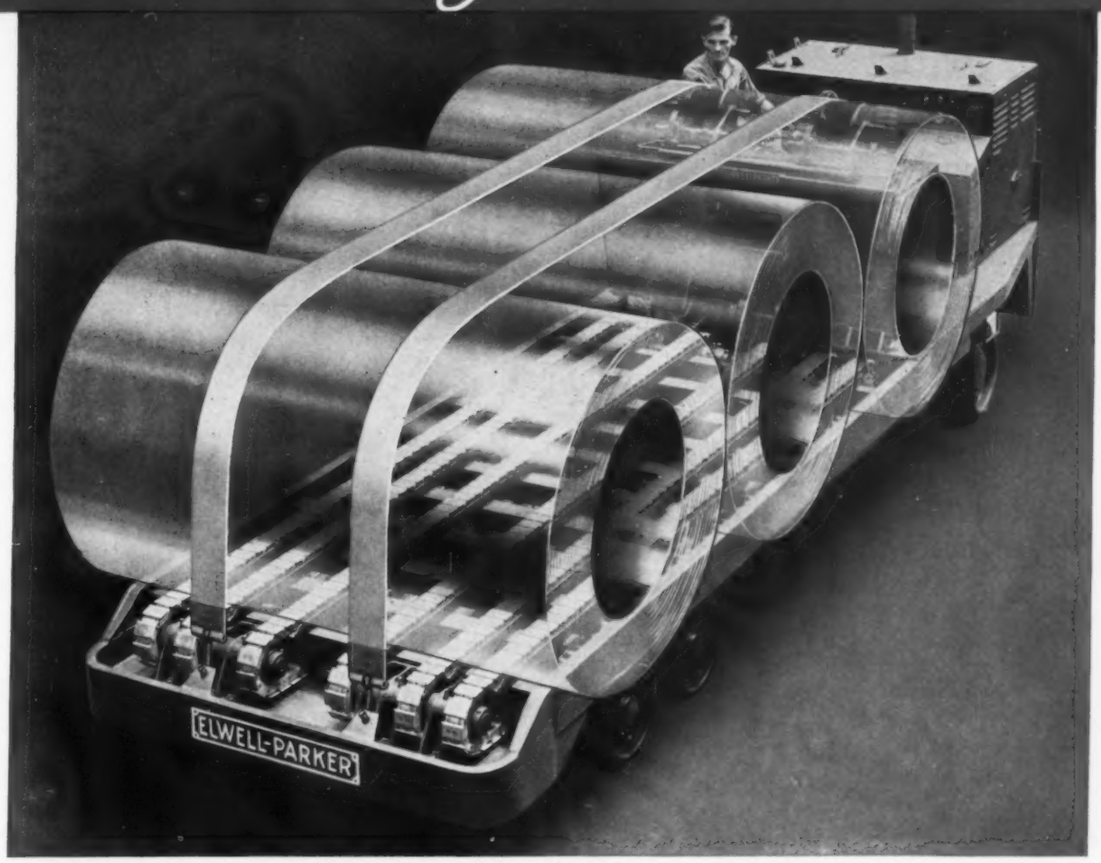
Robert W. Graham has been appointed superintendent of the new 100″ semi-continuous sheared-plate mill now under construction at the Homestead Works of the Carnegie-Illinois Steel Corporation. Mr. Graham started his steel career with the Youngstown Sheet and Tube Company, Campbell, Ohio; later with the Republic Iron and Steel Company, Youngstown, Ohio; coming to the Homestead Works in August 1925, where he has been continuously employed in positions of responsibility. Mr. Graham is a graduate of Carnegie Institute of Technology with the degree of Metallurgical Engineer.

KING H. McLAURIN

BENNETT M. LIVEZEY

ROBERT W. GRAHAM

GIANTS *of* TRUCKDOM



One of two gas-electric trucks recently delivered by Elwell-Parker for handling large to medium-size coils for a prominent manufacturer in the Chicago District . . . Maximum capacity, 3 coils 76″ long x 60″ diameter, weighing 40,000 lbs. Length overall, 21′. Coils are self-loaded by means of the power-operated chain conveyor built into the truck. Chains move the coils the full 12′ length of load deck. Control is effortless and completely automatic . . . Loads are transported from mill to mill, almost a half-mile, in approximately 6 minutes.

Whether you can use 1 or 10 Power Trucks like this giant, or none at all, you will find much of interest by examining the illustration anyway, because:—

1 *Best by Test.* This particular method of handling one, two or three big coils at a trip was *created* because it seemed to meet all of the owner's needs most satisfactorily. All feasible methods of doing the job were carefully analyzed—each of the others was discarded in turn.

2 *Combined Truck Engineering Skill.* The experience and skill of truck builders' engineering staffs, and also of the customer's engineers, were combined on working out main features and details of two of these self-loading trucks.

3 *Modern, Advancing Engineering Practice Based on 30 Years' Successful Experience.* The objective of Elwell-Parker Engineering is to find the *lowest-cost method* of handling any *kind* of material, in *volume,* for either *long or short distances.*

If a standard Elwell-Parker Truck, Tractor or Crane will do the job at greatest reduction in cost, well and good. Otherwise, Elwell-Parker does not hesitate to start from a fresh slant and design a whole new, practical System of Materials-Handling.

With such fundamental experience and capacity at their service, it is natural that concerns having peculiar problems should bring them here first; and that successfully meeting these problems gives Elwell-Parker a continually larger volume of problems to be worked out. Under no circumstances, however, will Elwell-Parker undertake to build an impracticable type.

A long-experienced Elwell-Parker Engineer located near you is available for the discussion of workable methods for reducing your costs of handling everything—whether transporting or shifting materials. Write or wire—we will send him promptly. The Elwell-Parker Electric Company, 4504 St. Clair Avenue, Cleveland, Ohio.

New Type **ELWELL·PARKER** *Trucks*

ESTABLISHED 1893 • BUILDING POWER INDUSTRIAL TRUCKS SINCE 1906

Frank M. Meredith has been appointed Assistant Director of Personnel of the Carnegie-Illinois Steel Corporation, with offices in Pittsburgh. His association with the United States Steel Corporation began in 1910 in the metallurgical department, National Tube Company, McKeesport, Pa., until 1917, when he entered the U. S. Army during the World War for 21 months in the 315th Machine Gun Co., 80th Division, serving overseas for 12 months.

After being mustered out of the army, he followed newspaper work for one year.

FRANK M. MEREDITH

In 1920 he entered the service of the Carnegie Steel Company, Duquesne Works, Duquesne, Pa., in the rolling mill department. For the last four years he has been active in industrial relations work for the Duquesne Plant.

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M. H. Mawhinney, former partner, and recently associated with the Salem Engineering Company as a consultant, has terminated his relations with that company.

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T. G. Baer has been appointed manager of the Buffalo office of the Timken Roller Bearing Company. Mr. Baer joined the Timken organization in 1929 immediately after finishing his engineering course at Purdue University. After completing his training in the Timken plant and engineering department Mr. Baer went to the Chicago office, where he has specialized on industrial sales.

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Thomas Cruthers has been appointed Vice-President of the Worthington Pump and Machinery Corporation. Mr. Cruthers' connection with Worthington dates from 1907. Graduated from Stevens Institute of Technology, where he received the degree of Mechanical Engineer, he first entered the employ of the Westinghouse Machine Corporation, during which connection he served as superintendent of Gas Engine erecting. In 1907, in the same capacity, he entered the service of the Snow Steam Pump Works, a Worthington subsidiary at Buffalo, New York. Transferred to the Worthington Sales Department in 1908, his first assignment was to the Pittsburgh District Office territory, and subsequently to various others of the Corporation's district offices until 1927, when he was appointed New York District Sales Manager.

In 1930 he was appointed Assistant General Sales Manager, and two years later was appointed Assistant Vice-President in Charge of Sales.

Mr. Cruthers will direct the Corporation's sales activities with large Steam Power Stations, the railroads, waterworks, sewage, drainage and irrigation projects. He will also have charge of general traffic department.

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Died

L. Richard Custer, general manager, Bethlehem Steel Company, Johnstown, Pa., died suddenly at his home July 31. He was 63.

L. RICHARD CUSTER

Mr. Custer entered the steel industry at the Homestead Plant of the Carnegie Steel Company, now a part of the United States Steel Corporation. Later he went to the Midvale Steel & Ordnance Company in Philadelphia as development engineer and in 1919 he went to Johnstown as vice president of the Cambria Steel Company under the Midvale regime.

At the time the Bethlehem Steel Corporation absorbed the Johnstown steel mills Mr. Custer became general manager of the Cambria Plant.

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Luther Burdick Weidlein, 55, sales manager, Arthur G. McKee & Company, died at his summer home, North Kingsville, Ohio, July 20, after a long illness.

He was graduated from Carnegie Institute of Technology in 1909 and was for several years with Carnegie Steel Company at Youngstown.

In 1919 he became associated with Arthur G. McKee & Company, becoming sales manager and a director in 1929.